MECHANICAL ENGINEERING

April 1957

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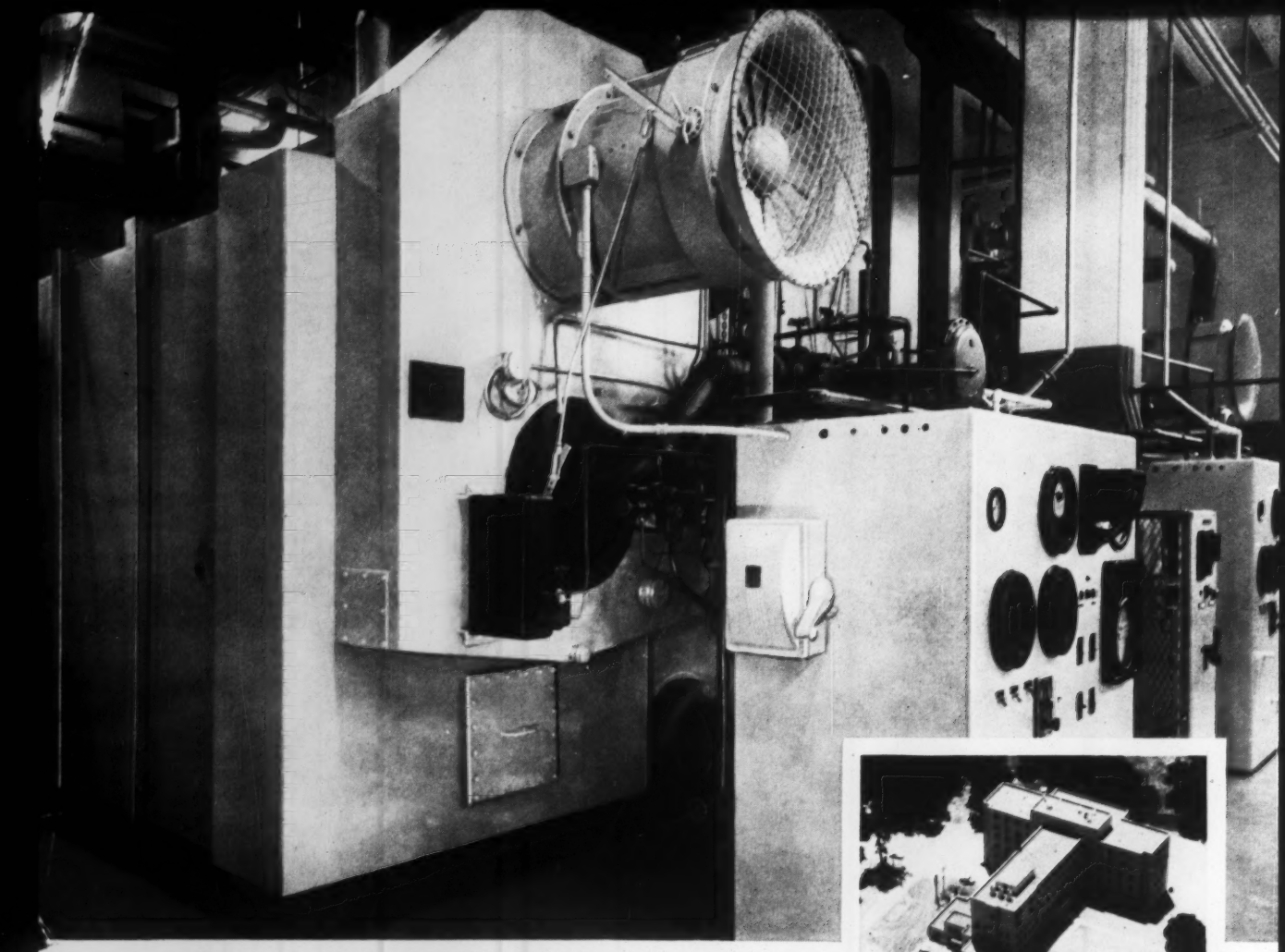
ASME Semi-Annual Meeting • San Francisco, Calif. • June 9-13, 1957



Dual unit installation of B&W Type FM Integral-Furnace Boilers at Barberton Citizens Hospital. Consulting Engineers: William E. Bodenstein and W. W. Shuster. Architects: Samuel Hannaford & Sons. Heating, Ventilating, Plumbing: T. O. Murphy Company.

Low Cost Steam Does Many Jobs

B&W 'PACKAGE' BOILERS SERVE BARBERTON CITIZENS HOSPITAL

Two B&W Type FM Integral-Furnace Boilers are the reliable source of plentiful, low cost steam that is put to many uses at Barberton Citizens Hospital, Barberton, Ohio. The gas-fired boilers, which can also use oil as a stand-by fuel, are automatically controlled to operate under minimum supervision.

Combined Capacity of the two units is 41,000 lbs of steam per hr, enough to supply an additional wing, should one be erected in the future. Both are "package" boilers, completely shop assembled. They only required service connections after installation.

The 250-Bed hospital, with a total of 560 rooms, uses steam for heating, sterilizers, a restaurant serving 37,000 meals a month, and a laundry that can handle 13½ pounds of linen per patient per day.

Long Life, low maintenance, reliability, continuity of operation, and efficiency have been proved for B&W Integral-Furnace Boilers in hundreds of installations in institutions and industry throughout the nation. They provide maximum capacity in small boiler room space, high fuel economy, and economical, fast steaming. They have built a reputation for quick response to wide load swings.

B&W Provides a single responsibility in design, engineering, manufacturing, installation, and service through a national network of plants and engineers. For detailed information on B&W Integral-Furnace Boilers, write for Bulletin G-76D. The Babcock & Wilcox Company, Boiler Division, Dept. AR-3, 161 East 42nd Street, New York 17, N. Y.

G-841-FM

BABCOCK & WILCOX

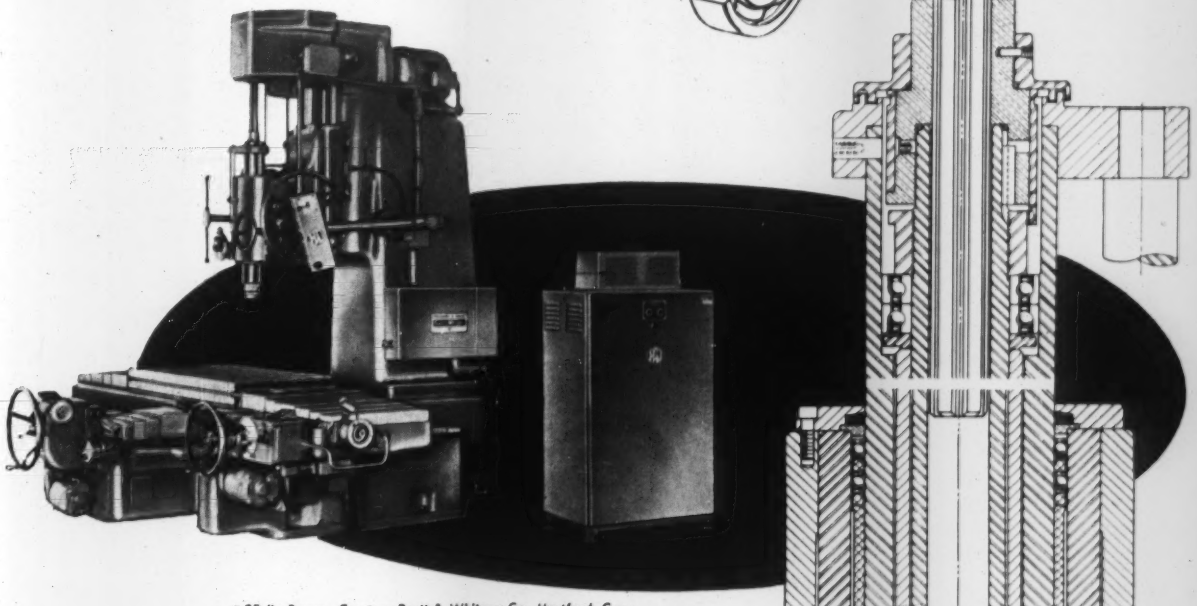
B&W

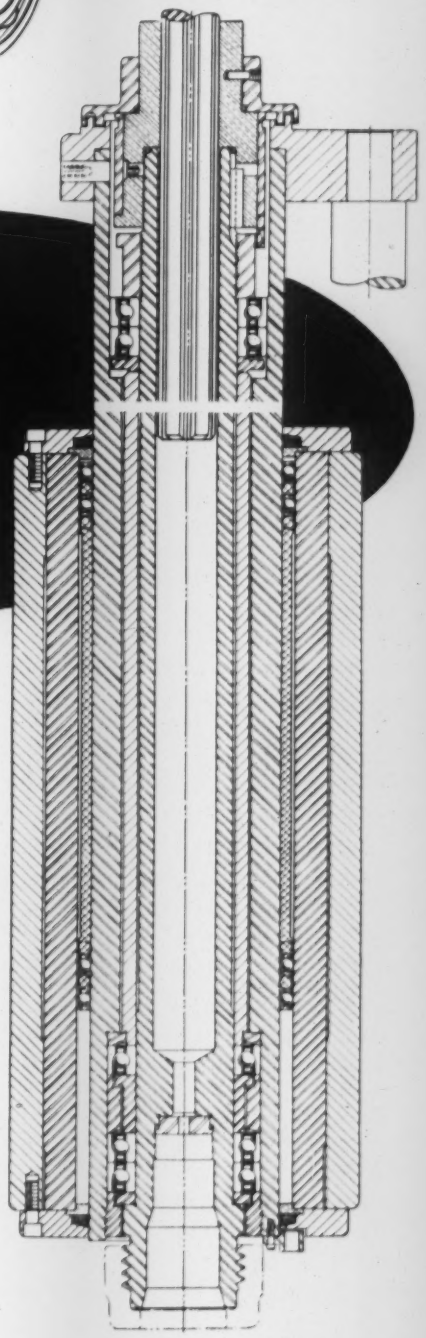
BOILER DIVISION

FACTS

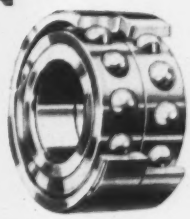
about

NEW DEPARTURE BALL BEARINGS





INVESTMENT IN PRECISION



No finely built machine entrusted with cutting metal to extremely small tolerances can be any more precise than the bearings on which its major rotating parts depend.

That's why you'll find this exquisitely accurate Jig Borer Spindle is mounted on New Departure preloaded duplex *ball* bearings. These bearings assure *permanent precision* through a wide range of speeds and feeds.

New Departure Duplex ball bearings are available in a complete range of sizes and series and are made to the finest precision tolerances.

As a further accuracy feature, the hardened, ground and lapped spindle quill moves on a large number of preloaded steel balls, thereby eliminating any clearances, however small, that would otherwise be required. For more details on New Departure preloaded duplex ball bearings, send for Catalog S.

SEE "WIDE WIDE WORLD" SUNDAYS—NBC-TV

BALL BEARINGS MAKE GOOD PRODUCTS BETTER

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONN.

MECHANICAL ENGINEERING, April, 1957, Vol. 79, No. 4. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York 18, N. Y. Price to members $3.50 annually, single copy 50¢, to nonmembers $7.00 annually, single copy 75¢. Add $1.50 postage to all countries outside the United States, Canada, and the Pan-American Union. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Member of the Audit Bureau of Circulations.

Hyatt's Simplified Fitting Practice for Bearing Races

HYATT pioneered the use of carburizing type alloys in order to obtain the advantages of heavier race fits

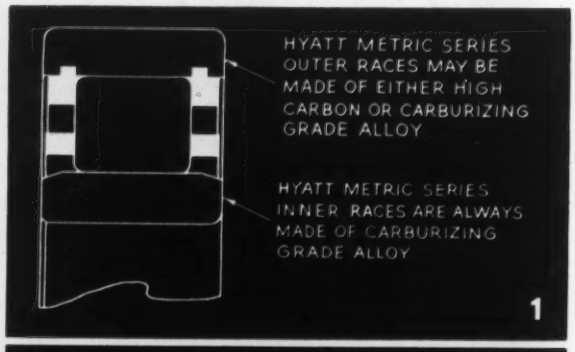
To obtain the best possible performance, roller bearing races must be assembled on shafts and in housings with certain fits developed by design and experience. The most frequent condition to be met is a rotating shaft where specific load and speed conditions must be satisfied with appropriate race fits. These vary according to the manufacturer, and in the case of some manufacturers, according to the application. Naturally, the fits will also vary according to bearing type and size.

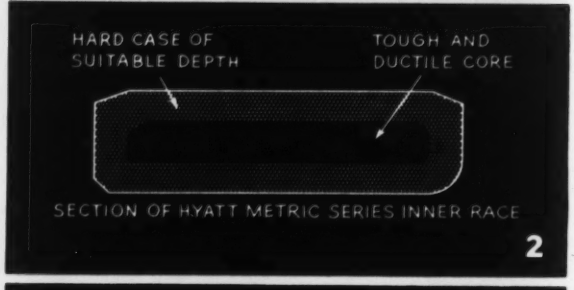
1. CARBURIZING PERMITS HEAVIER INTERFERENCE FITS

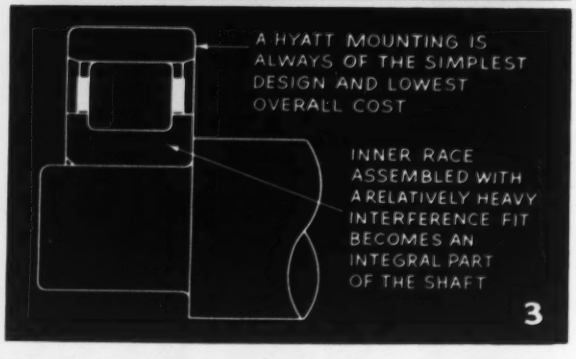
Taking the standard metric series of cylindrical roller bearings for an example, the bearing user has the choice of two fitting practices. One involves the use of inner races made of through-hardening steel, which dictates fairly light interference fits to avoid splitting. The other utilizes races made of low carbon steel *carburized* and hardened to develop a suitable surface hardness and a tough ductile core. The latter permits much heavier interference fits and has the additional advantage of eliminating all auxiliary holding devices, because the race becomes practically an integral part of the shaft. (Figs. 1, 2.)

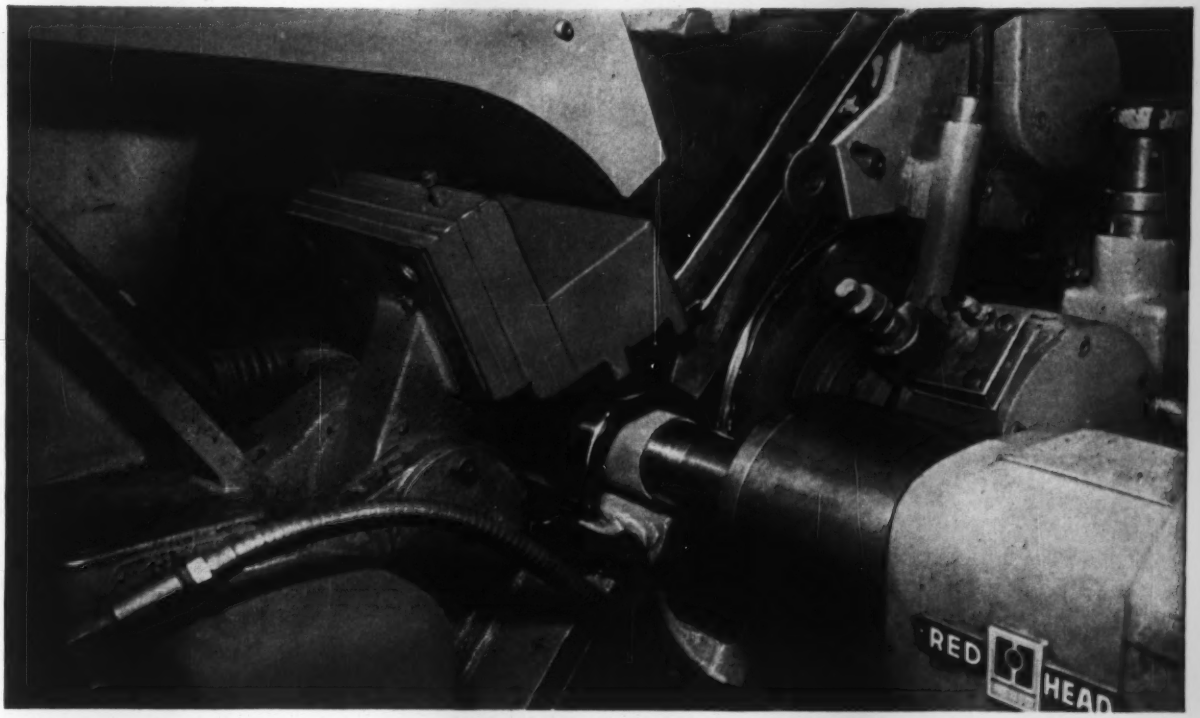
2. HEAVIER FITS SIMPLIFY MOUNTING, REDUCE COSTS

Hyatt originated the carburized race and the system of relatively heavy inner race fits to simplify bearing mounting and eliminate the need for retaining devices. Practically all HYATT inner races are made from nickel alloys of the carburizing type. They permit mountings of the simplest type and lowest over-all cost. Furthermore, the shoulders of HYATT carburized races will withstand considerably greater impact loads than will ordinary races. (Figures 3 and 4.)


HYATT METRIC SERIES OUTER RACES MAY BE MADE OF EITHER HIGH CARBON OR CARBURIZING GRADE ALLOY
HYATT METRIC SERIES INNER RACES ARE ALWAYS MADE OF CARBURIZING GRADE ALLOY
1




A HYATT MOUNTING IS ALWAYS OF THE SIMPLEST DESIGN AND LOWEST OVERALL COST
INNER RACE ASSEMBLED WITH A RELATIVELY HEAVY INTERFERENCE FIT BECOMES AN INTEGRAL PART OF THE SHAFT
3

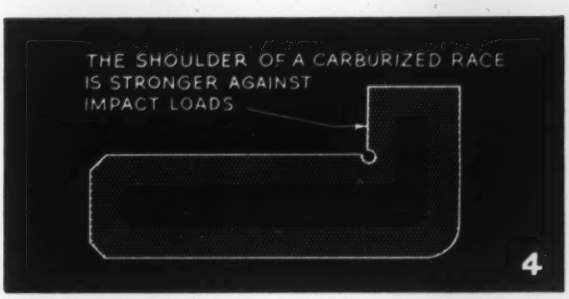


Hyatt inner race being centerless I. D. (inside diameter) ground to close tolerances.

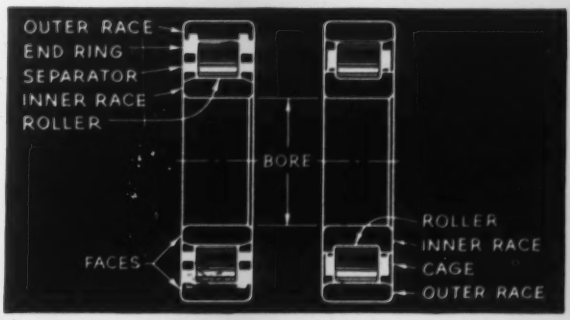
There are two fitting specifications which apply to HYATT inner races, depending on whether the inner race rotates or is stationary in operation. Remember, with both inner and outer race, the rotating member is assembled with heavier fit.

3. HYATT INNER RACES CAN BE EASILY SHRUNK ON SHAFTS

HYATT inner races may be mounted on shafts by pressing or shrinking. Where shrinking practice is employed, first heat the race in oil held at a temperature not over 300°F, or in an electric oven under a similarly controlled temperature, until it expands sufficiently to be slipped into position. The required interference fit will develop as the race cools in place. For special conditions of fit involving hollow shafts of varying sections or multiple housings of dissimilar metals, consult your HYATT Sales Engineer from our nearest sales office.



COMPONENT PARTS OF A HYATT ROLLER BEARING



YOU WILL FIND MORE DETAILS in HYATT Catalog No. 150. If you do not have a copy, write Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey. Sales offices at Harrison, Pittsburgh, Chicago, Detroit and Oakland, California.

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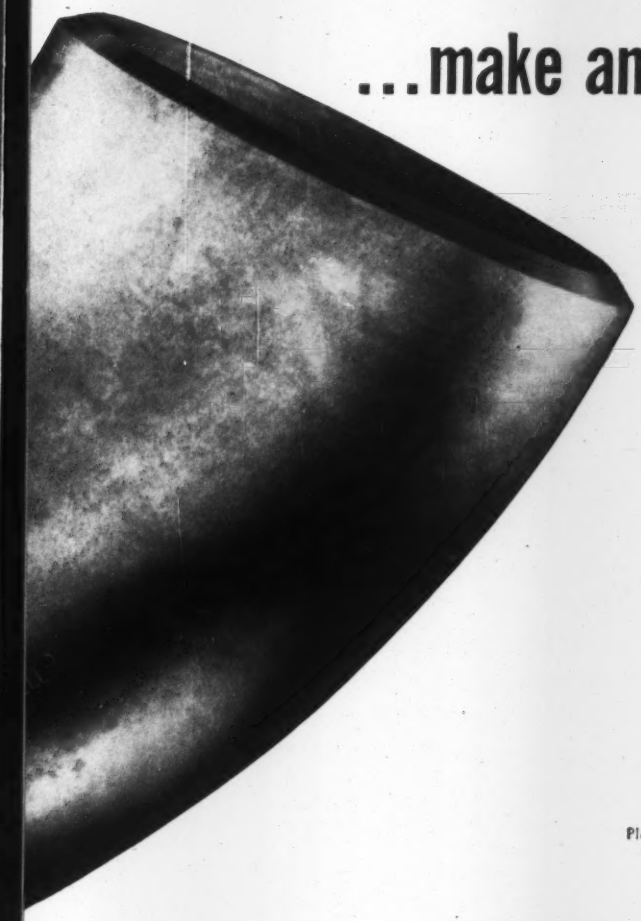
FORGE Welding Fittings and Forged Flanges



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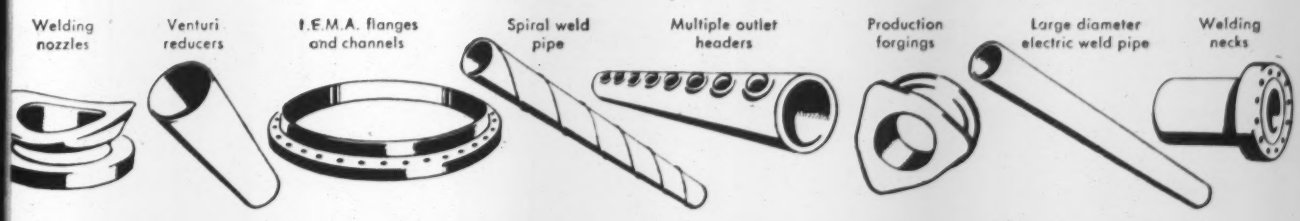
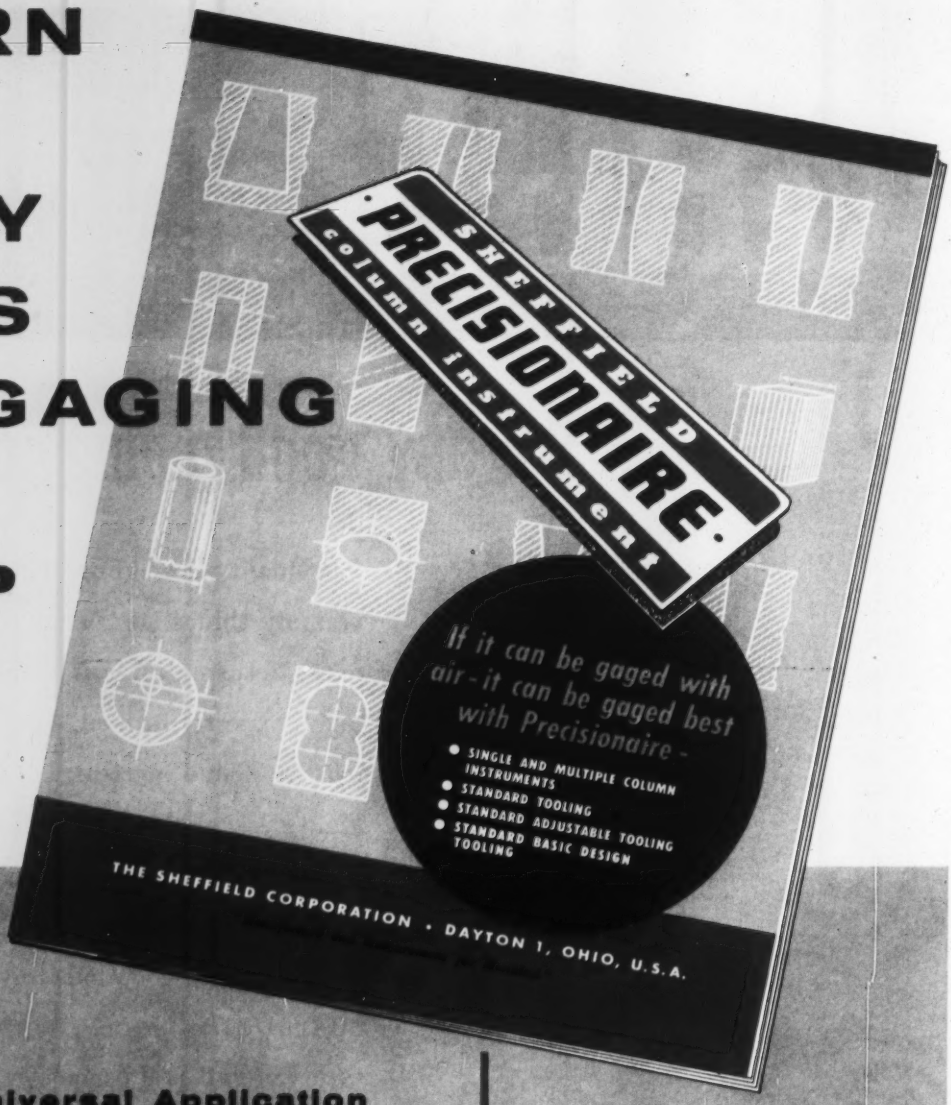


LEARN THE MANY WAYS AIR GAGING CAN HELP YOU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If it can be gaged with air - it can be gaged best with Precisionaire -
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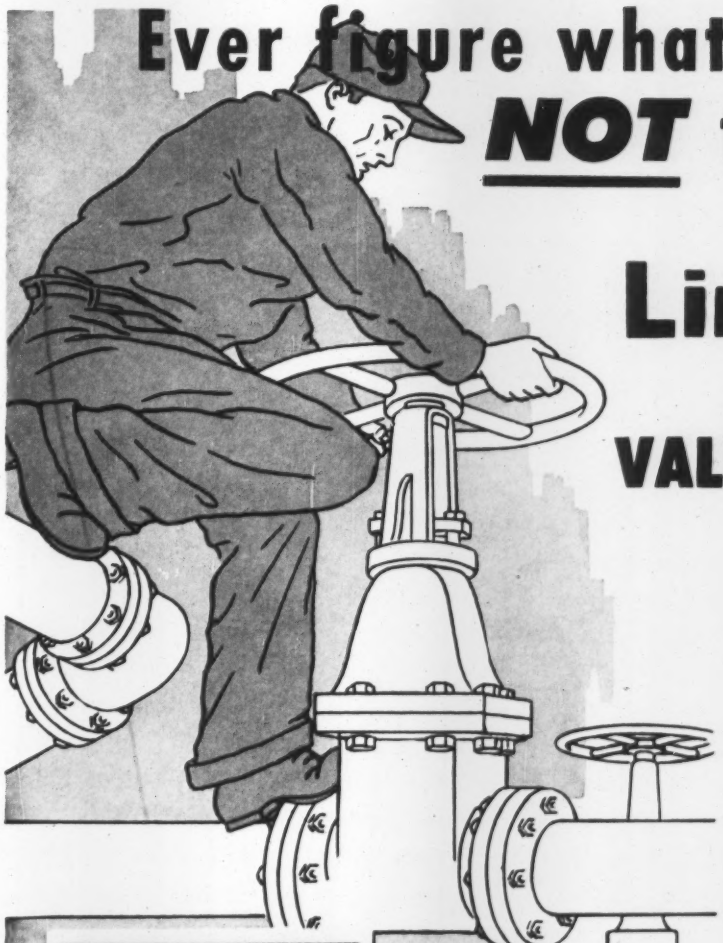
LimiTorque® *Automatic* VALVE OPERATION?



How much does opening and closing Valves *by hand* cost you—in man-hours—in physical danger to workmen who must climb to high or dangerous locations?

How much time, labor, and money could be saved in your plant by opening and closing valves *automatically*—at correct operating speeds—by the mere "push of a button"? With LimiTorque, one finger does the work of many hands. LimiTorque control permits one man to operate, and know the exact position of each valve from a central, conveniently located control panel.

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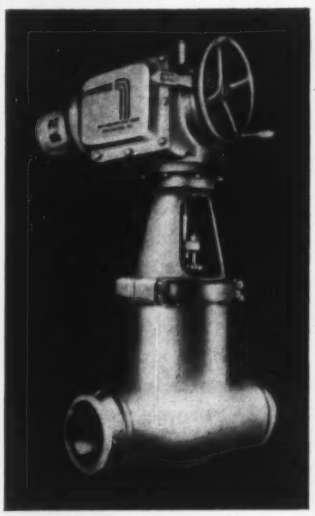

LimiTorque is, by far, the most widely used valve operator in the World . . . Send for complete new Catalog L-550, on your Business Letterhead.

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INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID MIXERS • FLEXIBLE COUPLINGS

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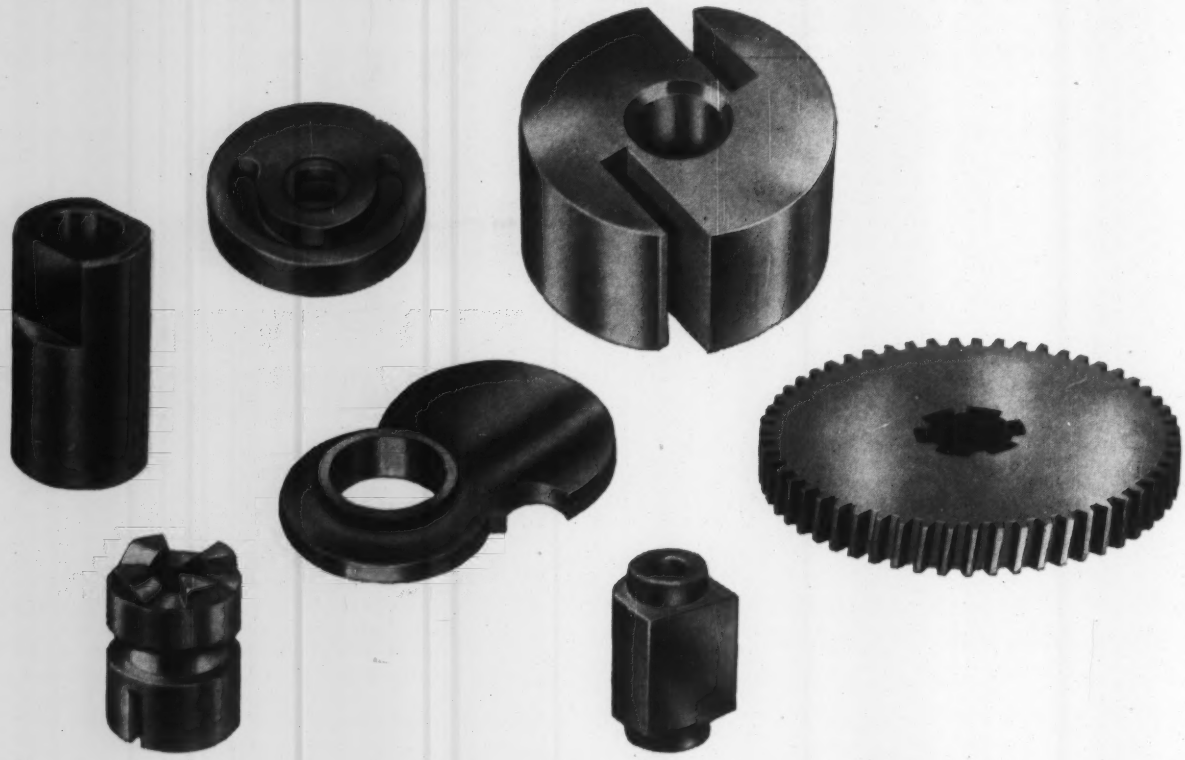

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Were you to machine the above parts from bar stock, or were you to finish them from rough castings or forgings, the cost would be considerable, due to their complex shapes. However, these parts—and thousands of others of comparable complexity—are produced economically by the GRAMIX process. GRAMIX parts are die-pressed to the exact shape desired, with tolerances as close as .0005", then sintered. Further machining is seldom necessary, though we often perform a coining operation to give the part a burnished, work-hardened surface. GRAMIX parts can be impregnated with various high-grade oils to furnish self-lubrication at wear surfaces. Alloys available include an extensive variety of brass, bronze, and ferrous types, and our manufacturing process allows us to accurately control the density of GRAMIX parts, assuring a uniform structure. There is probably a component in your product that could be improved with GRAMIX sintered metal parts . . .

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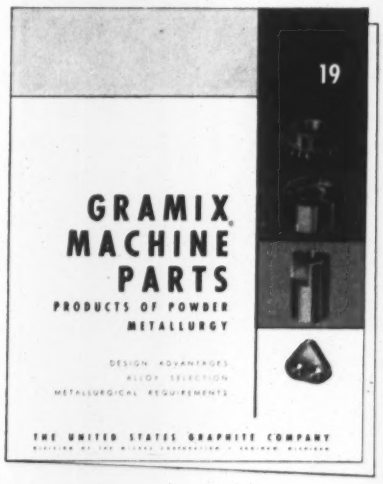


ENGINEERING BULLETIN No. 19

Product engineers specifying materials will find a wealth of design information in this GRAMIX Machine Parts Bulletin. This material is presented in such concise form that questions are quickly and easily answered. A simple chart indicates which alloys—ferrous and non-ferrous—are suitable for different operating requirements. Working sketches show the various design possibilities—radii, helical teeth, dead-end holes, flanges, multiple shoulders—and how they can be utilized to best advantage. Physical properties are presented, and metallography discussed. In all, you'll find Bulletin 19 an ideally simplified guide to a complex subject . . . write now for your copy. 118

GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION, SAGINAW 4, MICHIGAN

Seamless tube delivery gets **Triple protection in**

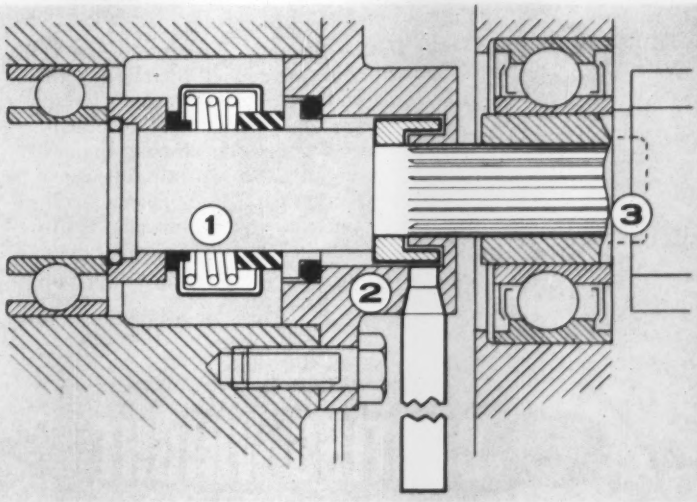
Westinghouse floating gearmotors

Westinghouse floating shaft gearmotors have undergone the critical tests of 24-hour-a-day, run-out table operations. Typical results come from a seamless tube drawing, tempering and annealing operation. Here, Westinghouse units bring three-way protection against the always-present problems of oil leakage and motor changes.

Two separate seal systems guard against oil leaking from the gear unit into the motor. An indicating feature warns of seal wear, before failure, in time for preventive maintenance.

Westinghouse splined shaft coupling permits easy separation of motor and gear assembly in seconds. Valuable inspection time is saved and motor changes can be made on the job, reducing down time.

Shock-absorbing spring mounting and rugged construction make Westinghouse floating-shaft gearmotors extremely tough . . . but why not see for yourself in Booklet B-6370. Call your local Westinghouse sales engineer for a copy, or write Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pa. J-07354



1. A combination labyrinth-packing and face-type seal on the pinion shaft prevents oil leakage from the gear housing into the motor.

2. For added protection an umbrella seal and drain catches any leakage through a worn shaft seal. Visual indication of seal wear is given by the drain.

3. The simple spline connection between motor and gear shafts permits fast demounting of the motor without disturbing gears or bearings.

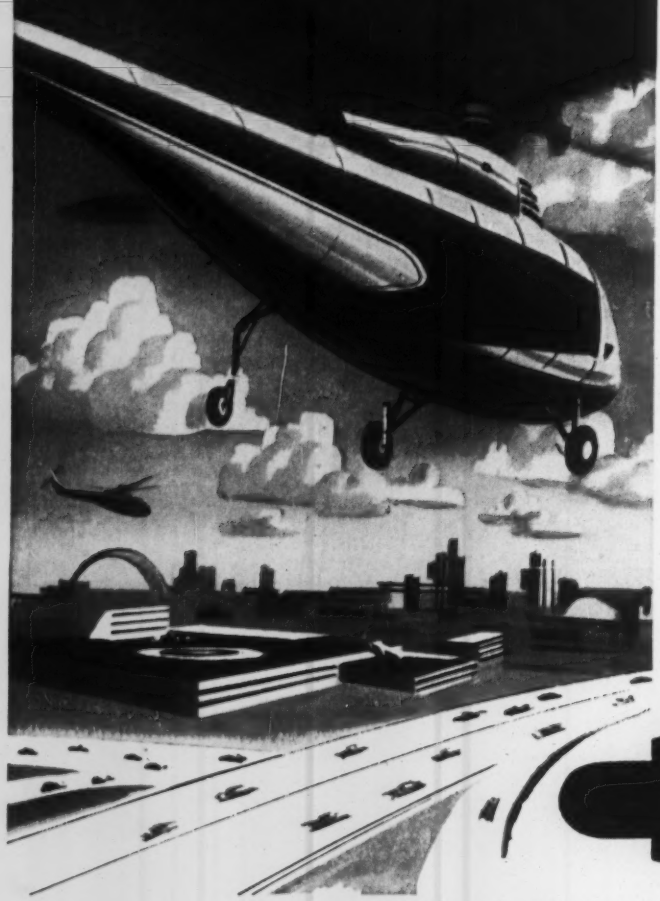
YOU CAN BE SURE... IF IT'S Westinghouse

COMPACT TURBO POWER

for aircraft and non-aircraft use

The small gas turbine engine—whether powering vehicles, small aircraft, drones, helicopters or missiles—is rapidly developing into an efficient and trouble-free source of power. Its bantam weight makes it ideal as auxiliary power . . . for thrust assists in aircraft applications . . . and for such functions as control of the "boundary layer" (friction-held air on the wing surfaces of high speed aircraft).

At Curtiss-Wright's Turbomotor Division—which has augmented operations with new modern facilities at Princeton, New Jersey—engineers are expanding the potentials of turbo power, developing engines for both aircraft and non-aircraft uses. Their answers are contributing to the overall advancement of the science of propulsion . . . continuing Curtiss-Wright's leadership in every major airpower category of today and of the future.



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ALL FORGED STEEL

Edward UNIVALVES

Lower Pressure Drop 25-50% with Straight-Thru Flow

As shown photographically here, the streamlined internal contours and the inclined stem construction of the Edward Univalve give straight through flow — which careful laboratory tests have shown to result in pressure drop 25 to 50% lower for Univalves than other globe valve types. Turbulence, too, is greatly lowered by these streamlined contours. And lowering turbulence lengthens valve life by eliminating vibration, the principal cause of wear in small globe valves.

But lower-pressure drop and less turbulence are not the only reasons the Univalve has become an industry standard for tough high pressure, high temperature services. Here are just a few of the benefits which add up to longer life and lower maintenance for this outstandi[illegible]ed Steel Valve.

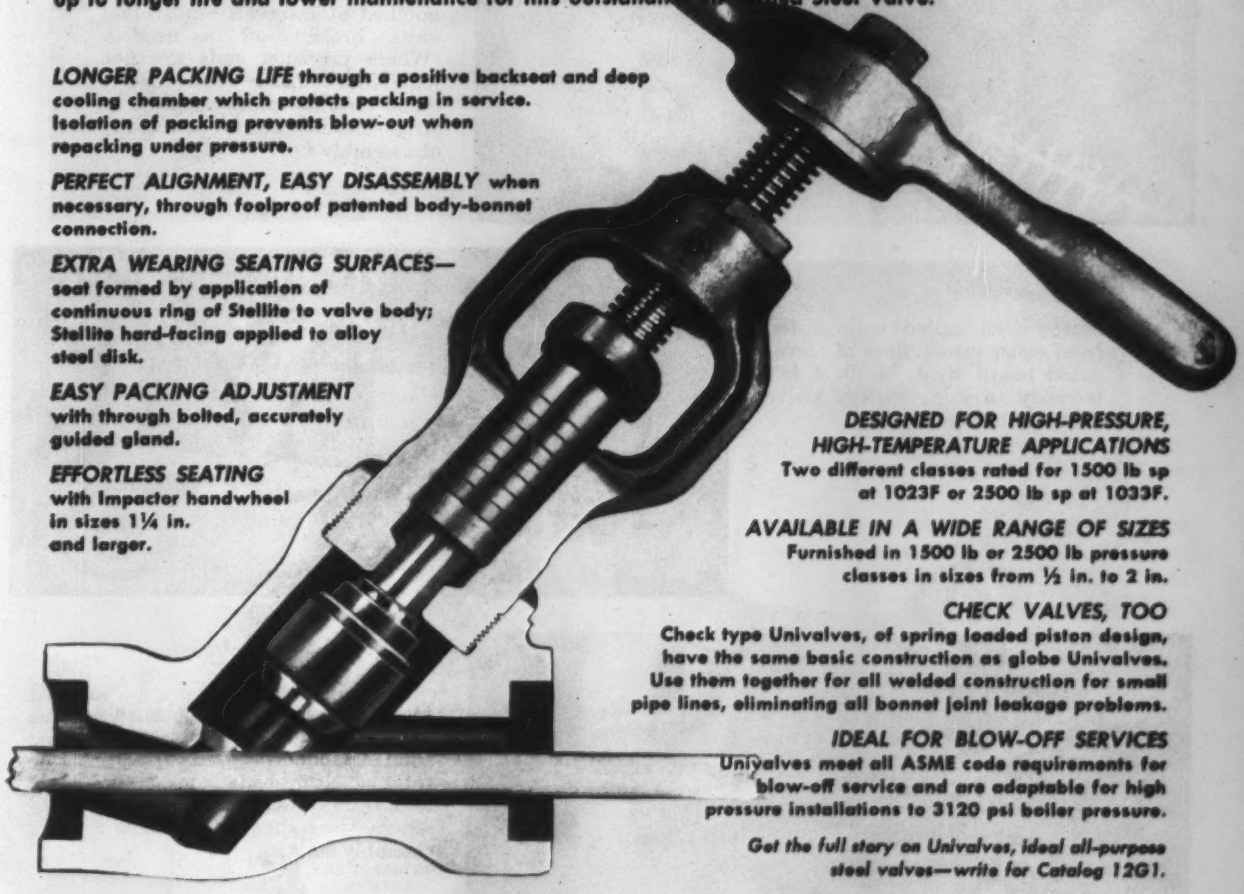
LONGER PACKING LIFE **through a positive backseat and deep cooling chamber which protects packing in service. Isolation of packing prevents blow-out when repacking under pressure.**

PERFECT ALIGNMENT, EASY DISASSEMBLY **when necessary, through foolproof patented body-bonnet connection.**

EXTRA WEARING SEATING SURFACES— **seat formed by application of continuous ring of Stellite to valve body; Stellite hard-facing applied to alloy steel disk.**

EASY PACKING ADJUSTMENT **with through bolted, accurately guided gland.**

EFFORTLESS SEATING **with impactor handwheel in sizes 1¼ in. and larger.**



DESIGNED FOR HIGH-PRESSURE, HIGH-TEMPERATURE APPLICATIONS
Two different classes rated for 1500 lb sp at 1023F or 2500 lb sp at 1033F.

AVAILABLE IN A WIDE RANGE OF SIZES
Furnished in 1500 lb or 2500 lb pressure classes in sizes from ½ in. to 2 in.

CHECK VALVES, TOO
Check type Univalves, of spring loaded piston design, have the same basic construction as globe Univalves. Use them together for all welded construction for small pipe lines, eliminating all bonnet joint leakage problems.

IDEAL FOR BLOW-OFF SERVICES
Univalves meet all ASME code requirements for blow-off service and are adaptable for high pressure installations to 3120 psi boiler pressure.

Get the full story on Univalves, ideal all-purpose steel valves—write for Catalog 12G1.

Rod through Univalve demonstrates straight thru flow of this valve.

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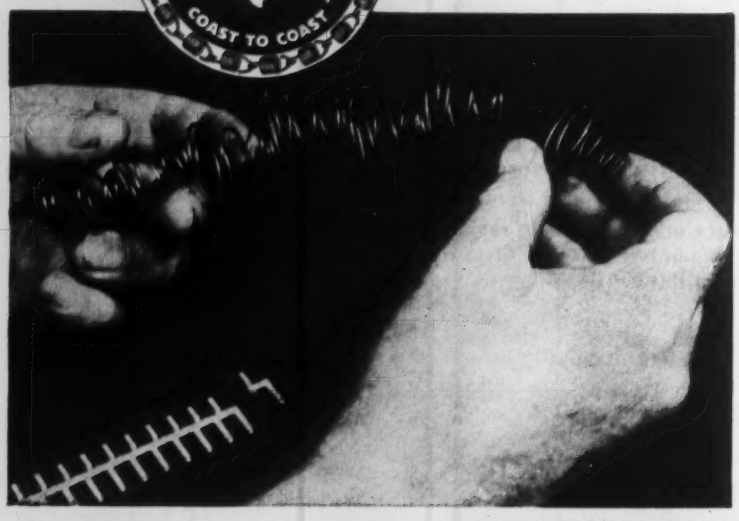
Another **Product**

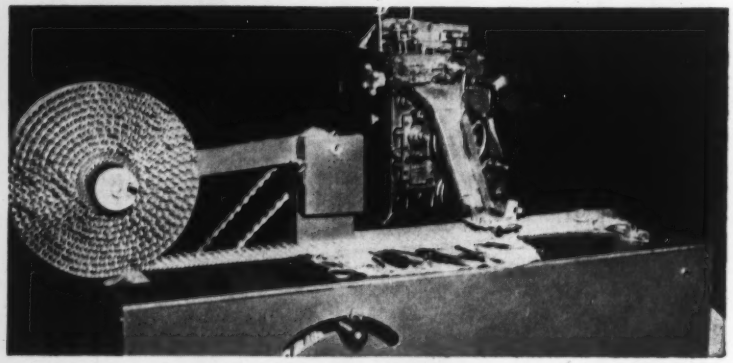
How Creative Spring Engineering Aids Automation...



"Designed Deliveries"

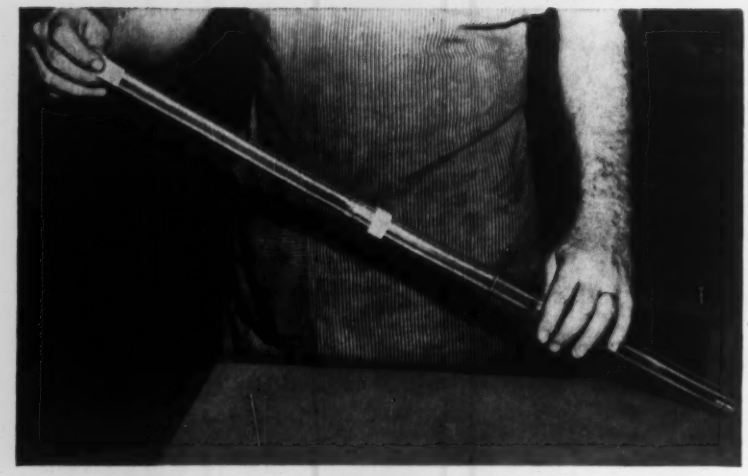
engineered by Divisions of Associated Spring Corporation can be time and money savers for spring users.

Continuous coiled springs are notched at intervals—individual units broken off as needed. (Where precision ends are not required.) *Lower left corner:* Small terminal plugs supplied in strips, also notched for ease in use at assembly line.



Small open coiled springs fed from coiler into valleys of corrugated board strip. Roll at left is ready to ship—springs arrive safely—untangled.

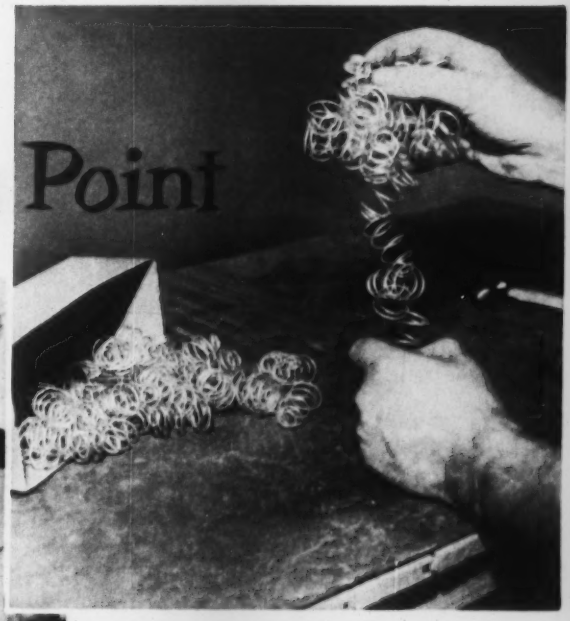
5705
© 1957 ASSOCIATED SPRING CORPORATION
BRISTOL, CONN., U.S.A.



Delicate wire heater elements are caught on a flat steel strip from machine—inserted in plastic tube which protects from distortion and atmosphere. Ready for automatic feeder in customer's assembly setup.

Divisions of

at the Assembly Point



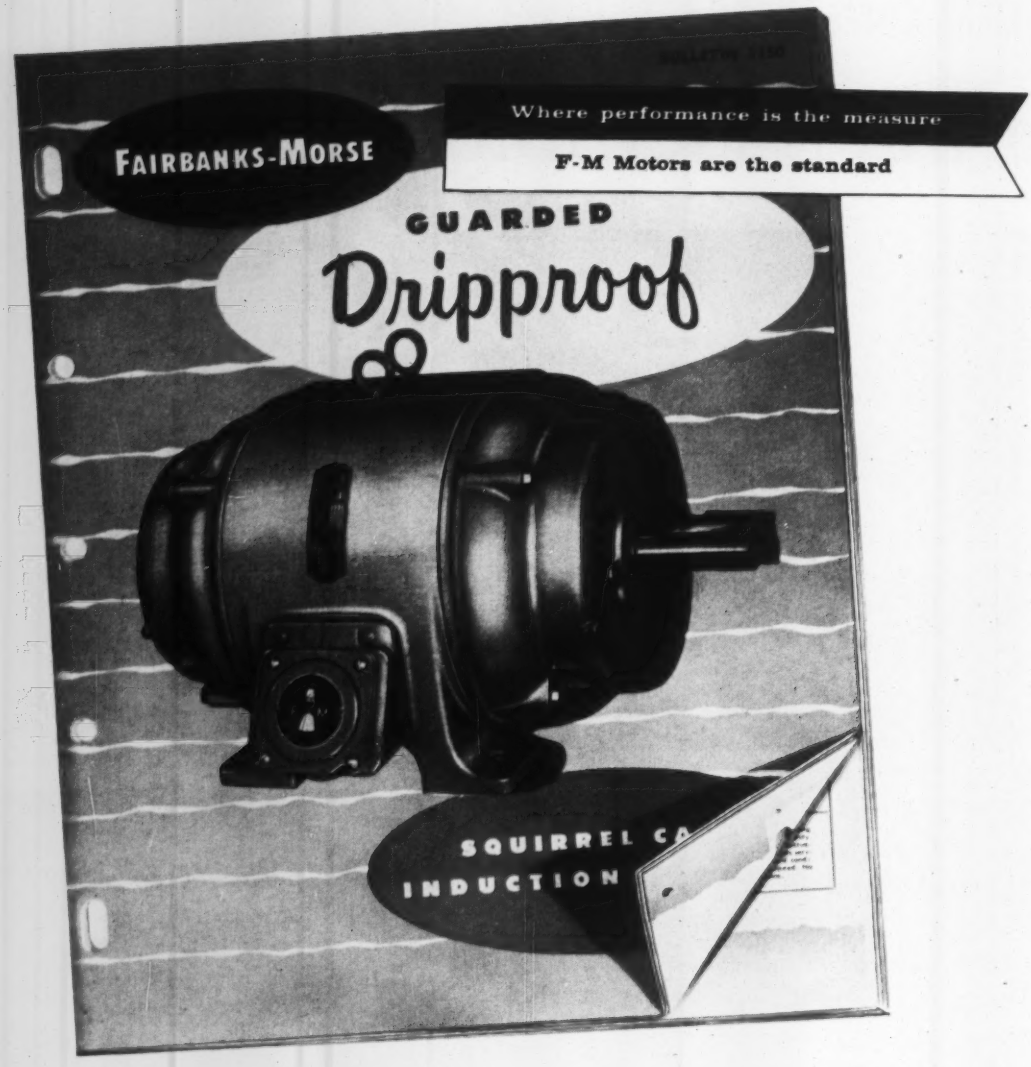
Before-and-after views show tangle of springs in bulk shipment—and same springs held on layers of pressure-sensitive tape ready for instant selection.

Tiny hairsprings for precision electrical meters are nestled in recessed pads, avoiding distortion from contact in shipment or storage at point of use.

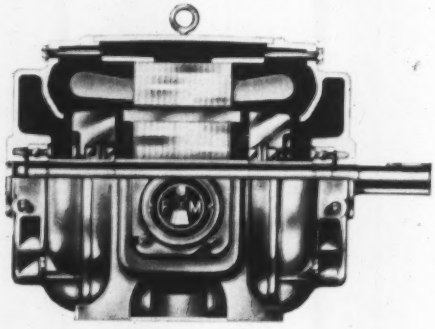
Do these examples suggest an approach to your spring problem? Write for pamphlet "M T M," giving further information.

ASSOCIATED SPRING CORPORATION

GENERAL OFFICES: BRISTOL, CONNECTICUT



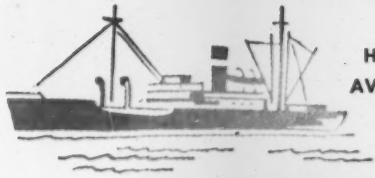
Get the inside story...



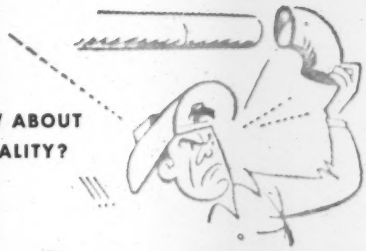
. . . of Fairbanks-Morse design and manufacture that set the standard of performance for motors that fulfill NEMA B, C and D requirements. Send today for Bulletin 1150 and get all the facts—including details on F-M exclusive Copperspun rotor.
Fairbanks, Morse & Co., Dept. ME-4, Chicago 5, Ill.

FAIRBANKS-MORSE
a name worth remembering when you want the BEST

ELECTRIC MOTORS AND GENERATORS • DIESEL LOCOMOTIVES AND ENGINES • PUMPS • SCALES • RAIL CARS • HOME WATER SERVICE EQUIPMENT • MOWERS • MAGNETOS



HOW ABOUT AVAILABILITY?

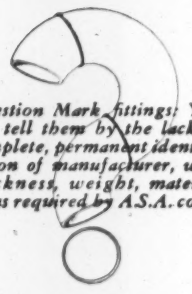


HOW ABOUT QUALITY?

HOW ABOUT IDENTIFICATION?

HOW ABOUT YOUR REPUTATION?

Why try to cut corners with *Question-Mark** fittings?



* *Question Mark fittings: You can tell them by the lack of complete, permanent identification of manufacturer, wall thickness, weight, material ... as required by A.S.A. code.*

Unknown welding fittings are as risky as unmarked turns on a busy highway. These blind spots in an expensive piping project cause slow-downs, confusion, trouble . . . waste time and money.

"Question Mark" fittings may look like a bargain on the price tag, but watch out for the after-costs . . . poor fit-up, impaired quality, questionable supply, lack of engineering service! Your reputation is at stake!

A message in the interests of top quality piping . . .
by Tube Turns, Louisville, Kentucky.

He knows he's getting the exact fitting specified on the blueprint because each TUBE-TURN product is clearly marked with all designations.

Save manhours...avoid piping risks with known fittings

You save purchasing time, get prompt delivery, speed up installation, and help assure reliable piping performance when you specify TUBE-TURN* Welding Fittings and Flanges. They meet all American Standard and Safety Code requirements. Each product is permanently marked with complete size and material designation. Your nearby Tube Turns' distributor gives you prompt delivery from the complete-line stock, and makes available Tube Turns' unmatched engineering service.

You *know* your piping investment is safeguarded when you specify and buy Tube Turns' products.

Your nearby Tube Turns' Distributor meets your needs promptly from the complete line of more than 12,000 Tube Turns' stocked items.

The Leading Manufacturer of Welding Fittings and Flanges

TUBE TURNS LOUISVILLE 1, KENTUCKY

A Division of National Cylinder Gas Company

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Chicago • Detroit • Atlanta • New Orleans • Houston • Midland Dallas • Tulsa • Kansas City • Denver • Los Angeles • San Francisco • Seattle

In Canada: Tube Turns of Canada, Ltd., Ridgetown, Ontario • Toronto, Ontario • Edmonton, Alberta

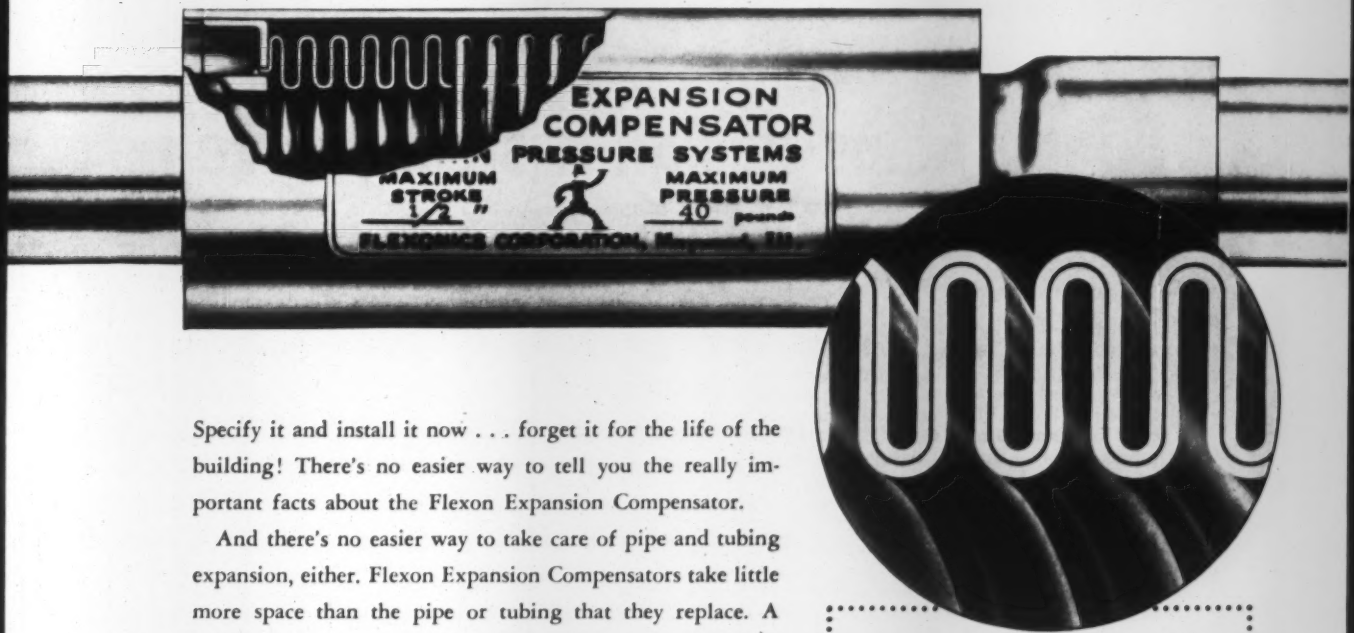
*"TUBE-TURN" and "tt" Reg. U. S. Pat. Off.

INSTALL IT...FORGET IT!

Flexon®

PACKLESS EXPANSION COMPENSATOR

the no-maintenance way to take up expansion in heating lines



Specify it and install it now . . . forget it for the life of the building! There's no easier way to tell you the really important facts about the Flexon Expansion Compensator.

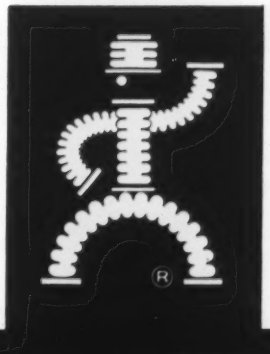
And there's no easier way to take care of pipe and tubing expansion, either. Flexon Expansion Compensators take little more space than the pipe or tubing that they replace. A mechanic can install one in minutes. Thousands of installations have proved them.

Standardize on this simple specification: Flexon Expansion Compensators for horizontal and vertical lines – Model L for low pressures – Model H for higher pressures. Write today for design and cost data.

The inside story

2-PLY CONSTRUCTION

The bellows is fabricated from two plies of specially-rolled metal to combine strength with flexibility. Bronze bellows for Model L; stainless steel for Model H.



Flexonics corporation

EXPANSION JOINT DIVISION • 1305 S. THIRD AVENUE, MAYWOOD, ILLINOIS

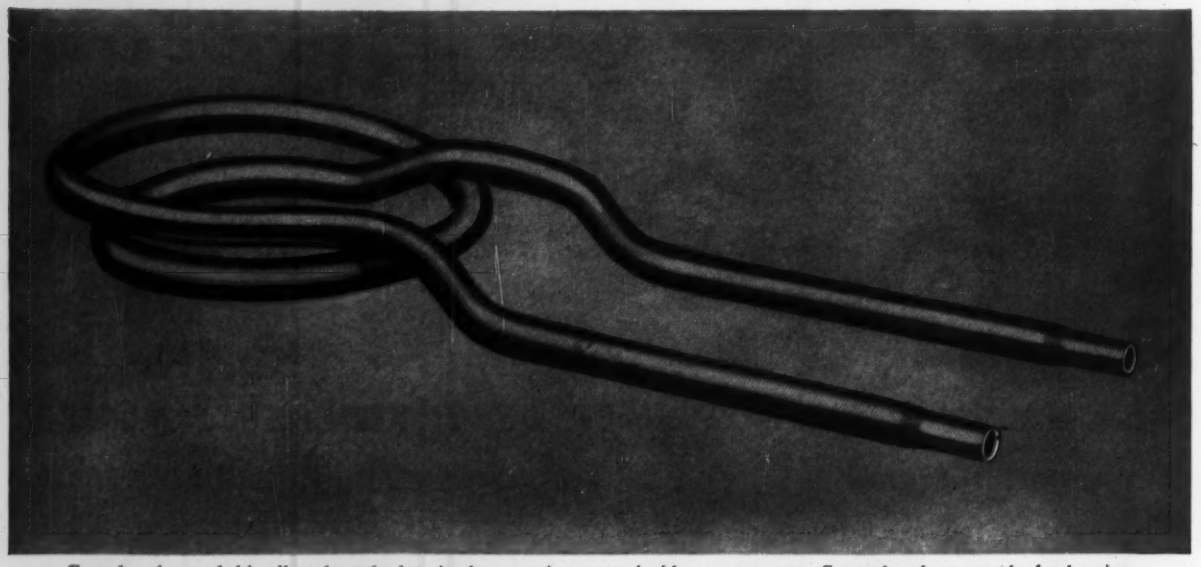
EXPANSION JOINTS

METAL HOSE

NON-METALLIC HOSE

BELLOWS

AIRCRAFT COMPONENTS



Complex shape of this oil-cooler tube lets it clear moving parts inside a compressor. Swaged ends are ready for brazing.

Bundy helps design a steel pretzel; bends it for Kelvinator compressor

Designing a compressor oil-cooler tube is tricky. It must bend like a pretzel to clear moving parts; stand up to punishing vibration indefinitely . . . yet be mass-produced quickly and economically. So when the problem arose, Kelvinator Division of American Motors Corp. consulted with the tubing experts—Bundy® design engineers.

Working together, Kelvinator and Bundy designers carefully plotted the intricate bends needed for clearance within the compressor. Next, their design took form in Bundyweld® Tubing. Bundyweld is ductile enough for easy fabrication . . . strong enough to withstand vibration fatigue . . . yet costs less than the material used in previous designs. Finally, the job was turned over to Bundy's modern tubing-fabrication facilities for mass production.

This is but one of the countless problems solved by teamwork between Bundy and our customers in many industries. In addition to years of experience, we have the advantage of working with Bundyweld—the only small-diameter tubing made by the exclusive process shown below. *Leak-proof by test*, Bundyweld is the safety standard of the refrigeration and automotive industries . . . *is used on 95% of today's cars, in an average of 20 applications each.*

If you have tubing design or fabrication problems, Bundy has the answers. It will pay you to call, write, or wire us today!

BUNDY TUBING COMPANY • DETROIT 14, MICHIGAN

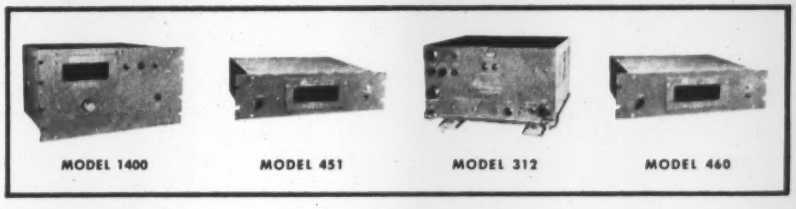
WORLD'S LARGEST PRODUCER OF SMALL-DIAMETER TUBING. AFFILIATED PLANTS IN AUSTRALIA, ENGLAND, FRANCE, GERMANY, AND ITALY

Bundyweld starts as a single strip of copper-coated steel. Then it's
. . . continuously rolled twice around laterally into a tube of uniform thickness and passed
through a furnace. Copper coating fuses with steel. Result . . .
Bundyweld, double-walled and brazed through 360° of wall contact.

NOTE the exclusive Bundy-developed beveled edges, which afford a smoother joint, absence of bead, and less chance for any leakage.

BUNDYWELD® TUBING

DOUBLE-WALLED FROM A SINGLE STRIP



MODEL 1400 Wide Range Voltmeter—Utilizes mercury wetted relays for maximum life and reliability.

MODEL 451 General Purpose Voltmeter—For display or recording of ±0.001 to ±999.9 volts DC.

MODEL 312 High-Speed Voltmeter—For airborne analog-to-digital conversion.

MODEL 460 High Sensitivity Voltmeter—For thermocouple and strain gage systems.

It's as simple as 1, 2, 3, for even untrained personnel to clearly and accurately make electrical measurements with NLS digital meters. Inch-high numerals are legible from 30 feet away. NLS originated the automatic digital voltmeter and now manufactures a broad range of these and other precise, related instruments for both laboratory and industry. Accuracy, ruggedness, and dependability are proven features of these digital meters for measuring resistance or voltage. Automatic data recording on Clary printer, electric typewriter, card, or paper punching equipment is available. Whatever your need for high speed, completely reliable electric measurement instruments, you'll find your answer in the NLS complete line. Write on your letterhead for the name and address of your nearest NLS representative, who will be glad to discuss your needs, or mail the coupon for full information on these high precision instruments.

One of the many EXCLUSIVE FEATURES *pioneered by* NLS... *Oil immersed stepping switches that insure trouble-free life and dependable operation.*

Originators of the Digital Voltmeter

NLS **non-linear systems, inc.**

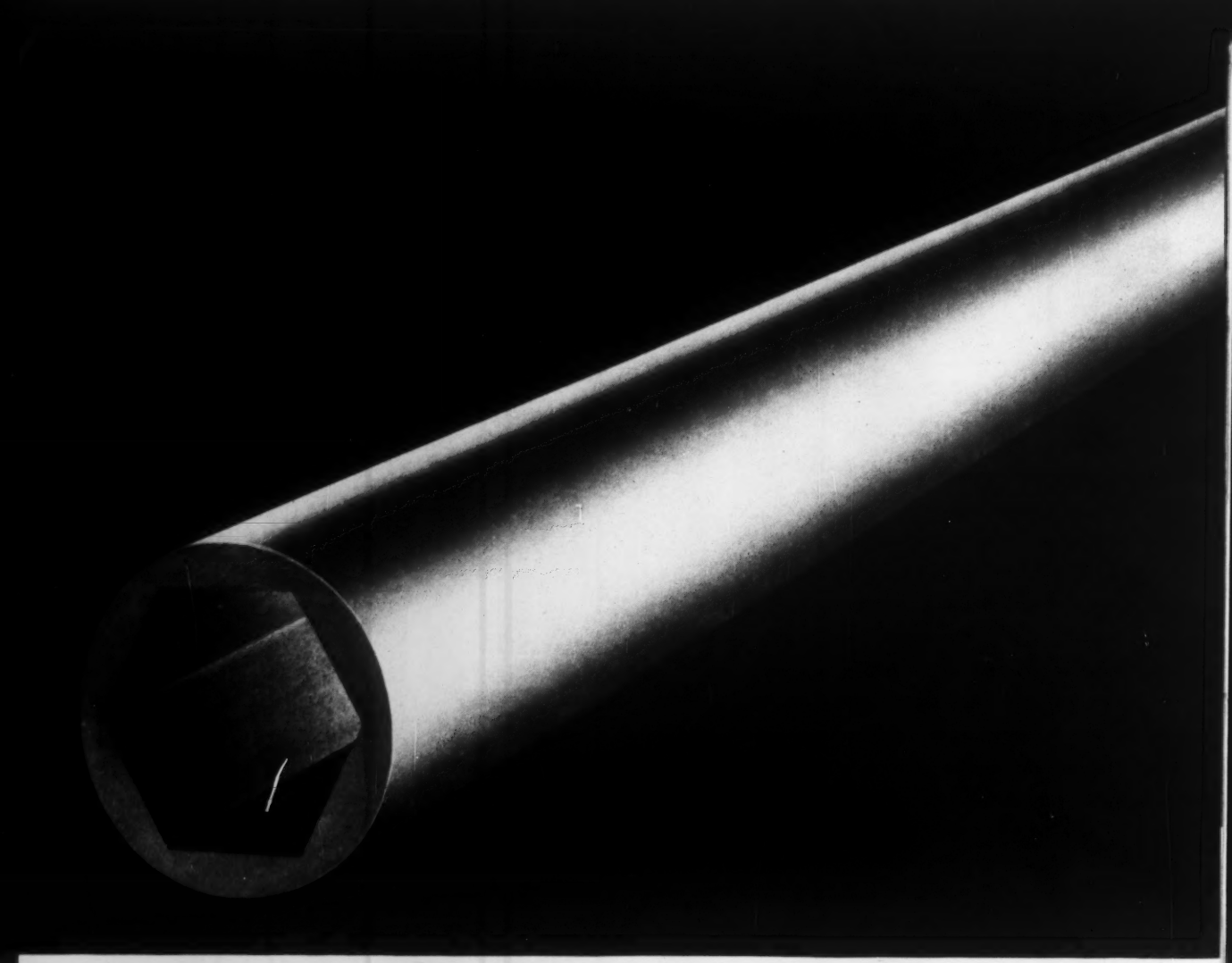
Del Mar, Calif. • Phone: SKyline 5-1134

Digital Ohmmeters • AC-DC Converters • Data Reduction Systems • Digital Readouts • Peak Reader Systems • Binary Decimal Converters • Digital Recording Systems

100

NON-LINEAR SYSTEMS, INC.
Dept.E-547, Del Mar Airport, Del Mar, Calif.
Please send technical information on:
☐ AC or DC voltmeters ☐ ohmmeters
☐ analog-to-digital converters ☐ automatic testing systems

NAME _____
COMPANY _____
ADDRESS _____
CITY _____ ZONE ____ STATE _____



EVER TRIED MACHINING A SPECIAL I.D. SHAPE?

—in stainless steel, with each part 22 inches long, the outside diameter a shade over 2 inches and with tolerances of +.000″ to −.010″ across the flats?

On jobs like this, there's possible trouble ahead if you start with solid stock, or even round heavy wall tubing. Machining problems, surface finishing, scrap loss, special cutting oils or compounds—added to the original stock cost may make the final cost of the part prohibitive.

There is one sure way of minimizing your production problems and costs involving hollow cylindrical parts and products—*DESIGN WITH B&W MECHANICAL TUBING.*

Before you start your next production run, call Mr. Tubes at your nearby B&W Tubular Products Division District Sales Office—let him match tubing steels, types, finishes, shapes and tolerances to your applications—he will show you how to keep final costs low. Or write for bulletins 361 and 340. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pa.

TA-6086-M2

Seamless and welded tubular products, seamless welded fittings and forged steel flanges—in carbon, alloy and stainless steels.

BRASS keeps sales up... manufacturing costs down

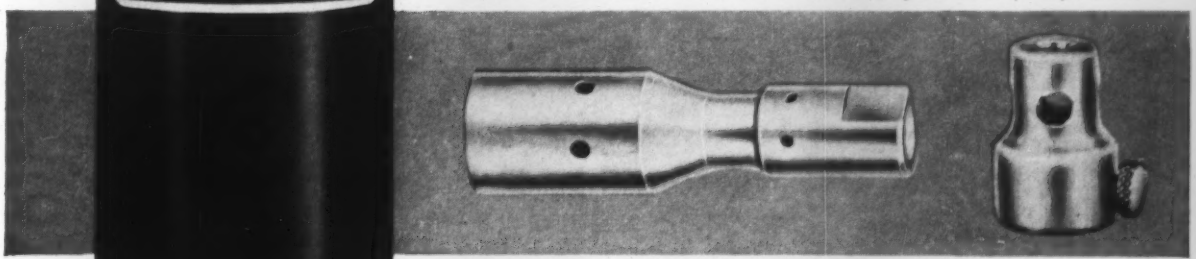
TURNER IS A LONG-TIME USER OF ANACONDA BRASS ROD AND TUBE— GIVES 10 REASONS WHY—

Blow torches built by The Turner Brass Works, Sycamore, Ill., have a reputation for dependable operation and long life. Since 1871, brass has been used consistently in their construction and has built a quality reputation for Turner. Turner prefers Anaconda Brass as a quality metal and looks to The American Brass Company as a quality source of supply. 6673

These are the reasons given:

1. Brass is the quality material needed for the service.
2. Brass is easily machined at high speed, with less tool breakage — manufacturing costs are 15% lower than with other metals.
3. Close tolerances are easily held with brass.
4. Threading holds well — yet accessories are easily screwed on and off.
5. Brass takes a good finish — polishing is easy and economical.
6. Clean, polished brass products have proven high sales appeal.
7. Brass stands up under alternate heating and cooling.
8. Brass resists corrosion — the torches are used on land and sea, throughout the world.
9. Brass gives superior wear on valve seats.
10. Brass has high public acceptance as a quality material.

Turner liquefied petroleum torch No. LP-555, with disposable fuel tank. Below are accessories of brass—holder for soldering tip and a heavy-duty burner.



The American Brass Company, Waterbury 20, Conn.
In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

ANACONDA®

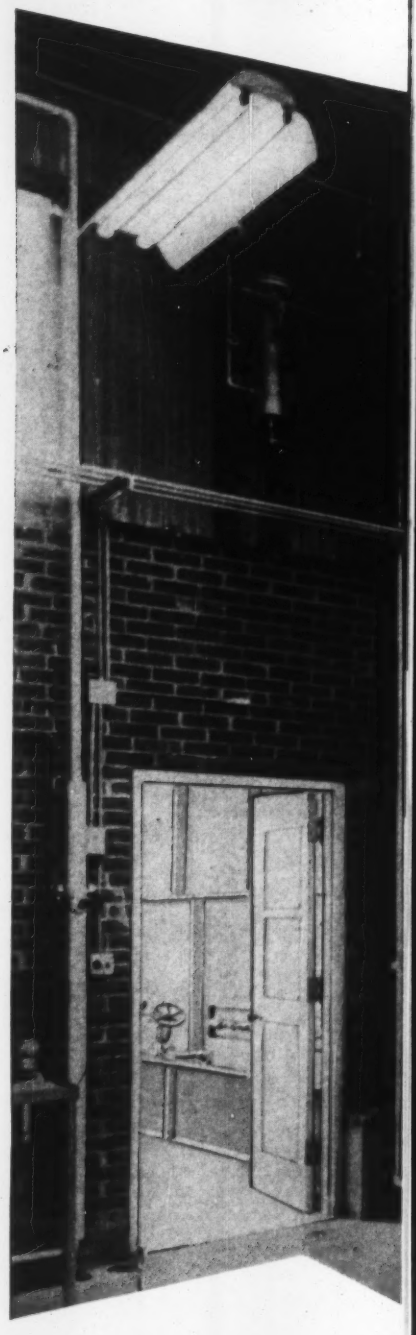
COPPER • BRASS • BRONZE

ERIE CITY

For Future... Stoker Firing

• Now it's possible to obtain the advantages of completely packaged gas and oil fired steam generators and still provide for future stoker firing. Erie City VL's are designed as a true package with furnaces properly proportioned and arranged for easy conversion to stoker firing.

These Erie City VL type package steam generators are arranged for either forced or induced draft operation and are shipped shop assembled with brickwork installed. Controls and Burners are piped, wired and mounted — and remember — Erie City package boilers are Factory Fire Tested prior to shipment. All this ready for your basic service connections plus having a boiler designed for the future installation of an Erie City stoker. Write for Catalog SB-434D.



2 Additional Units Now Installed

• *When American Synthetic Rubber Corporation of Louisville, Kentucky modernized its steam facilities, they turned to Erie City Packaged Power. Installed there are three 25,000 pounds per hour VL type packaged steam generators complete with Erie City steam atomizing combination gas and oil burners and arranged for the future installation of Erie City Underfeed Stokers.*

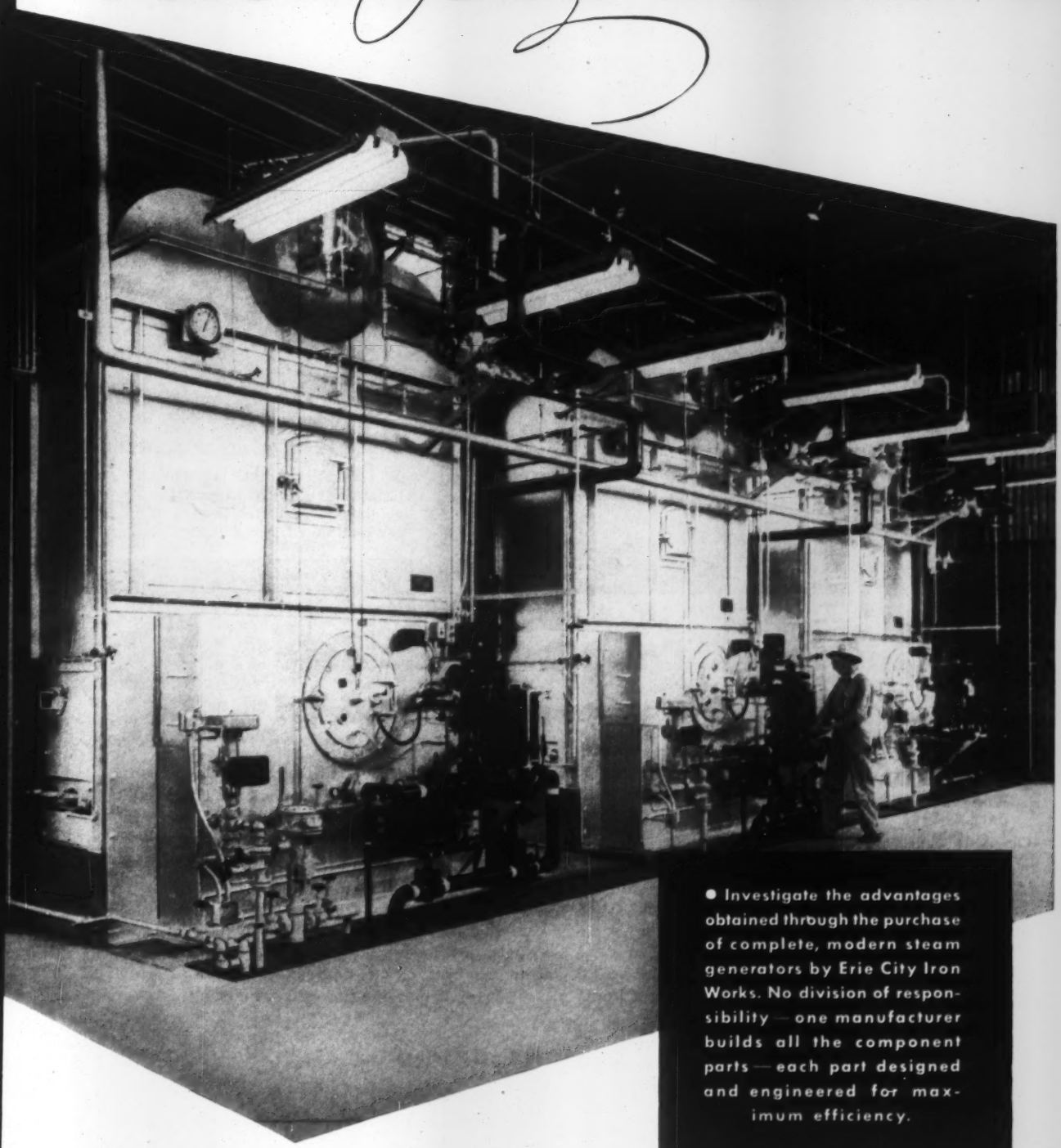
ERIE CITY
117 Years in Steam Generation

You can depend on Erie City for sound engineering

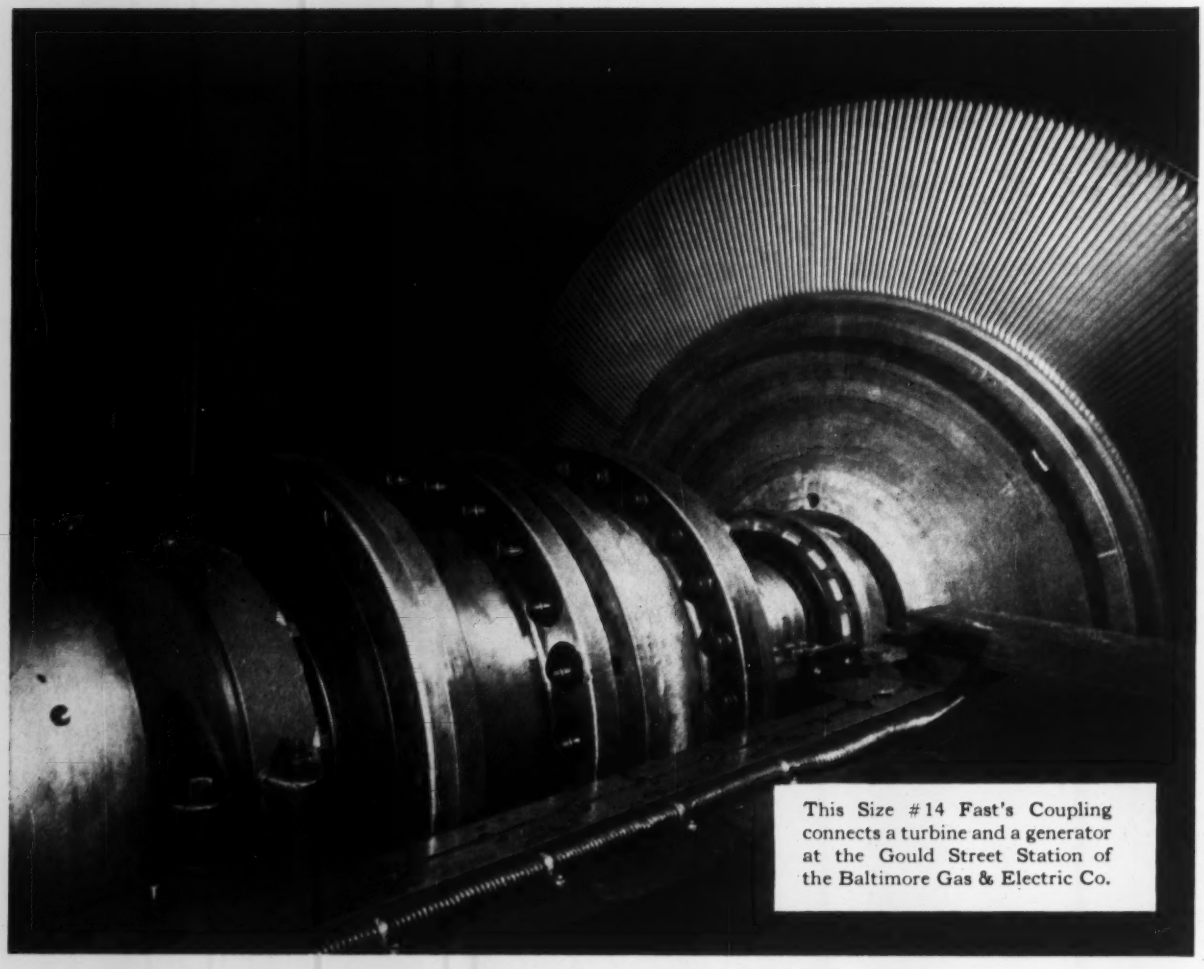
ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

Oil and Gas
PACKAGED BOILERS



• Investigate the advantages obtained through the purchase of complete, modern steam generators by Erie City Iron Works. No division of responsibility — one manufacturer builds all the component parts — each part designed and engineered for maximum efficiency.



This Size #14 Fast's Coupling connects a turbine and a generator at the Gould Street Station of the Baltimore Gas & Electric Co.

This Fast's Coupling runs smooth after 29 years of service!

This Size #14 Fast's Coupling has never had a major part replaced since its installation on January 4, 1927.

The Baltimore Gas & Electric Company has provided excellent care and inspection . . . examining the coupling during each routine overhaul of the turbine and generator. The last inspection (shown above) was during the fall of 1955.

Unique design permits Fast's Couplings to compensate for both offset and angular misalignment of shafts and eliminates the wear of metal upon metal. It provides positive lubrication which forms a film on load-carrying surfaces of the teeth. Metal bearing rings located at the mid-axis of the teeth keep out dirt, grit and moisture—keep lubricant in. Fast's metal-to-metal seal protects the lubricant against pollution.

A Koppers engineer can show you how Fast's Couplings will give you extra years of service and reduce down-time. For more details, write to: KOPPERS COMPANY, INC., *Fast's Coupling Dept.*, 3404 Scott Street, Baltimore 3. Maryland.

Koppers Company, Inc.
Metal Products Division
Baltimore 3, Maryland

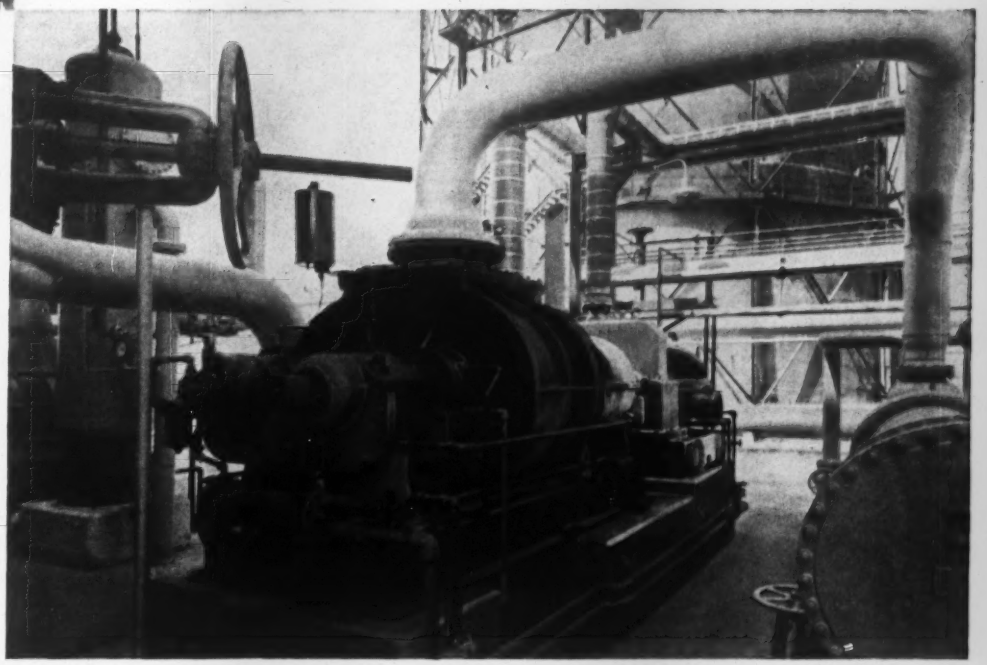
***Engineered* Products**
Sold With *Service*

KOPPERS

THE ORIGINAL
FAST'S Couplings

MATHIESON

For Olin Mathieson



R-C pumps and blowers control air and gas mixing

In the manufacture of ammonia at this large Olin Mathieson chemical plant at Lake Charles, Louisiana, large volumes of hydrogen, nitrogen and air are positively proportioned and compressed by Roots-Connersville equipment.

R-C Gas Pumps are teamed with Rotary Positive Blowers to handle pure hydrogen gas and air for processing into a 3:1 hydrogen-nitrogen synthesis. Another R-C Gas Pump compresses this mixture to supercharge other equipment.

Inherently high efficiency of the famous R-C rotary positive design, extremely low friction loss and extra deep stuffing boxes are a few of the reasons why this equipment delivers maximum performance within rated capacities.

Here is another example of the widespread application of R-C equipment in the process industries. If you have a product or a process requiring handling and accurate control of air or gas, Roots-Connersville engineers will welcome the opportunity to give you the benefit of their long experience. Address your inquiry to Product Development Manager.

R-C Rotary Positive Equipment purchased for this installation

22 x 29 Gas Pump rated 4975 cfm, 514 rpm, 425 Hp

14 x 28 Gas Pump rated 4250 cfm, 830 rpm, 112 Hp

10 x 18½ Blower rated 1770 cfm, 830 rpm, 37.6 Hp

The 14 x 28 Gas Pump and 10 x 18½ Blower are direct-driven in a single assembly.

The 22 x 29 Gas Pump functions as a supercharger for the 3:1 hydrogen in nitrogen gas mixture.

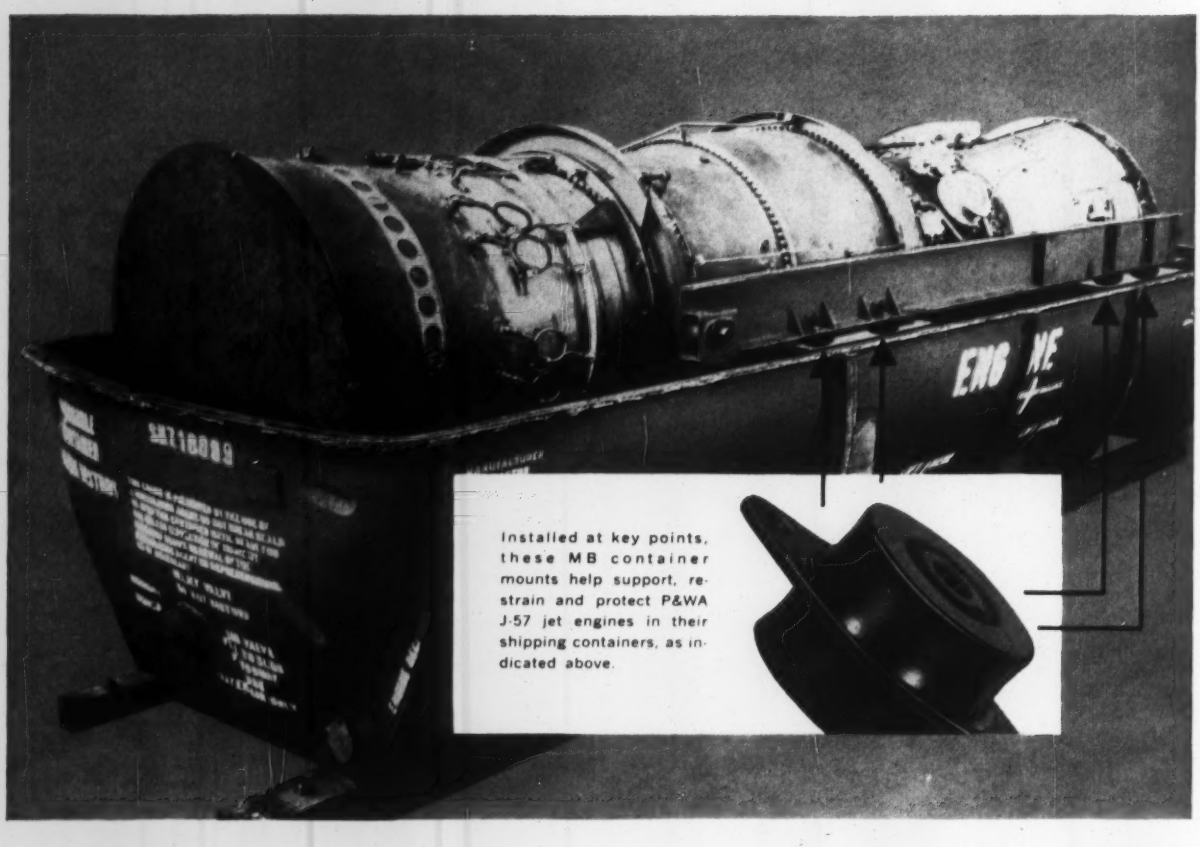
ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.

457 Michigan Ave., Connersville, Indiana. In Canada – 629 Adelaide St., W., Toronto, Ont.

Engineers – unusual career opportunities await you at Roots-Connersville. Address your resume to Professional Employment Manager.

MB mounts restrain "canned" jet engines


Installed at key points, these MB container mounts help support, restrain and protect P&WA J-57 jet engines in their shipping containers, as indicated above.

Jet engines can experience vibration and shock problems before ever seeing service. It happens during transportation and handling, when they're in their shipping cans.

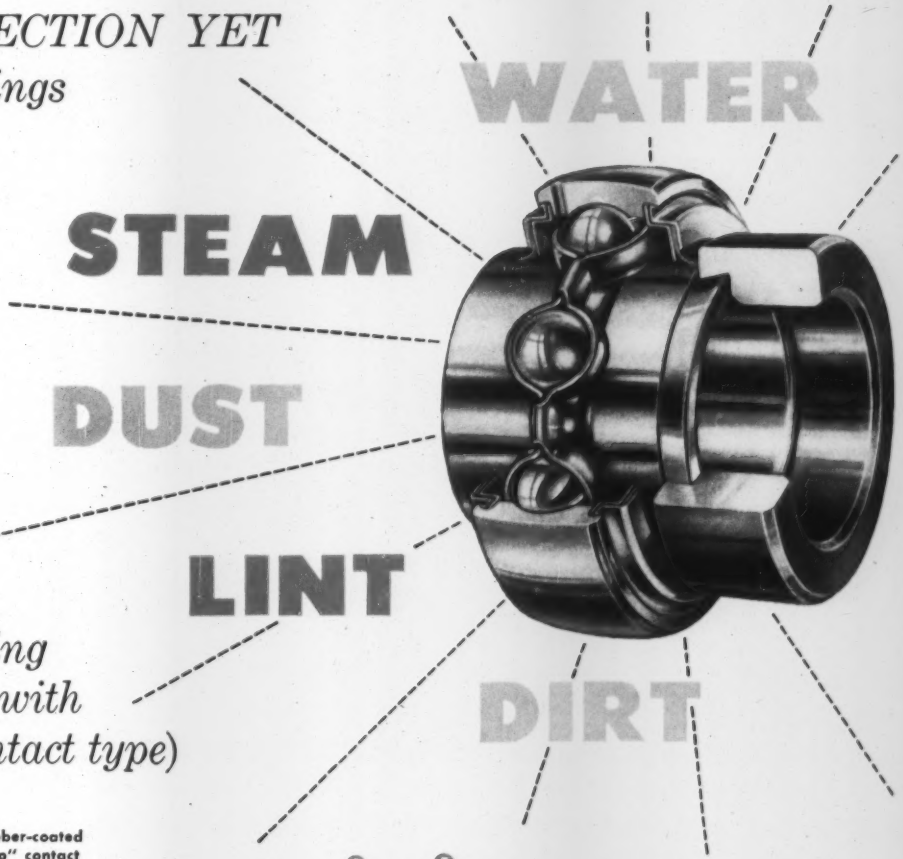
So special MB shock mounts are used to help protect P&WA J-57 engines in their containers. These units satisfy two important yet different performance requirements. They'll safely restrain the displacement and maximum "g" of the engine should the container be dropped even 3 feet. At the same time, they provide the cushioned mass with a natural frequency different from frequencies encountered in transportation, thereby avoiding resonance and consequent build-up of vibratory amplitudes.

MB concentrates on mounts which start where ordinary units have to give up. Various mounts have been developed which, while available as *standard* units, are actually in the *special performance* class. Perhaps we can work out a modification of one to solve *your* particular vibration problem. Send for Bulletin 616A.

manufacturing company
A Division of Textron Inc.
1074 State Street
New Haven 11, Conn.

HEADQUARTERS FOR PRODUCTS TO ISOLATE VIBRATION . . . TO EXCITE IT . . . TO MEASURE IT.

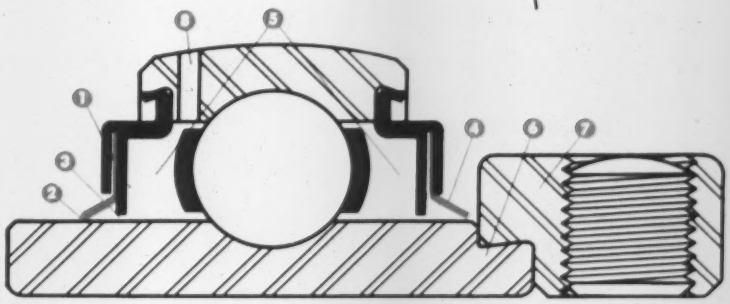
BEST PROTECTION YET
for Ball Bearings
exposed to



FAFNIR
Wide Inner Ring
Ball Bearings with
Plya-Seals (contact type)

FEATURES

1. Plya-Seal of resilient Buna N rubber-coated fabric insuring proper "follow-up" contact
2. Seal rides in firm contact on ground outside diameter of inner ring
3. Close-clearance of inside metal shield with outside diameter of inner ring provides rigid support for seal
4. Flared lip of Plya-Seal won't push in
5. Generous space for lubricant
6. Wide inner ring for extra shaft support
7. Fafnir-originated self-locking, eccentric-cam-design collar
8. Relubricatable



On slow to moderate speed applications where service conditions are subject to excessive contamination, Fafnir Plya-Seal equipped Wide Inner Ring Ball Bearings fill a definite need. Their laboratory and field-tested performance offers the proven protection of contact-type Plya-Seals. They provide every advantage of Fafnir Wide Inner Ring Ball Bearings with Self-Locking Collars . . . ease of application, positive locking, extra large support area on the shaft, relubricatable or nonrelubricatable, self-alignments.

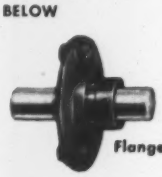
The Plya-Seal as incorporated in the Fafnir Wide Inner Ring Bearing consists of two steel plates between which is sandwiched a synthetic rubber-coated fabric sealing washer. Both steel plates are fixed securely in an outer ring groove. The inner plate provides a rigid backing for the seal and a close-clearance baffle for the retention of grease.

This recent addition to the Fafnir Line is dimensionally interchangeable with the Fafnir Wide Inner Ring Ball Bearings equipped with Mechani-Seals. All types are prelubricated at the factory. Write for descriptive bulletin. The Fafnir Bearing Company, New Britain, Connecticut.

FAFNIR WIDE INNER RING BALL BEARING WITH PLYA-SEALS AVAILABLE IN UNITS BELOW

RAK

RCJ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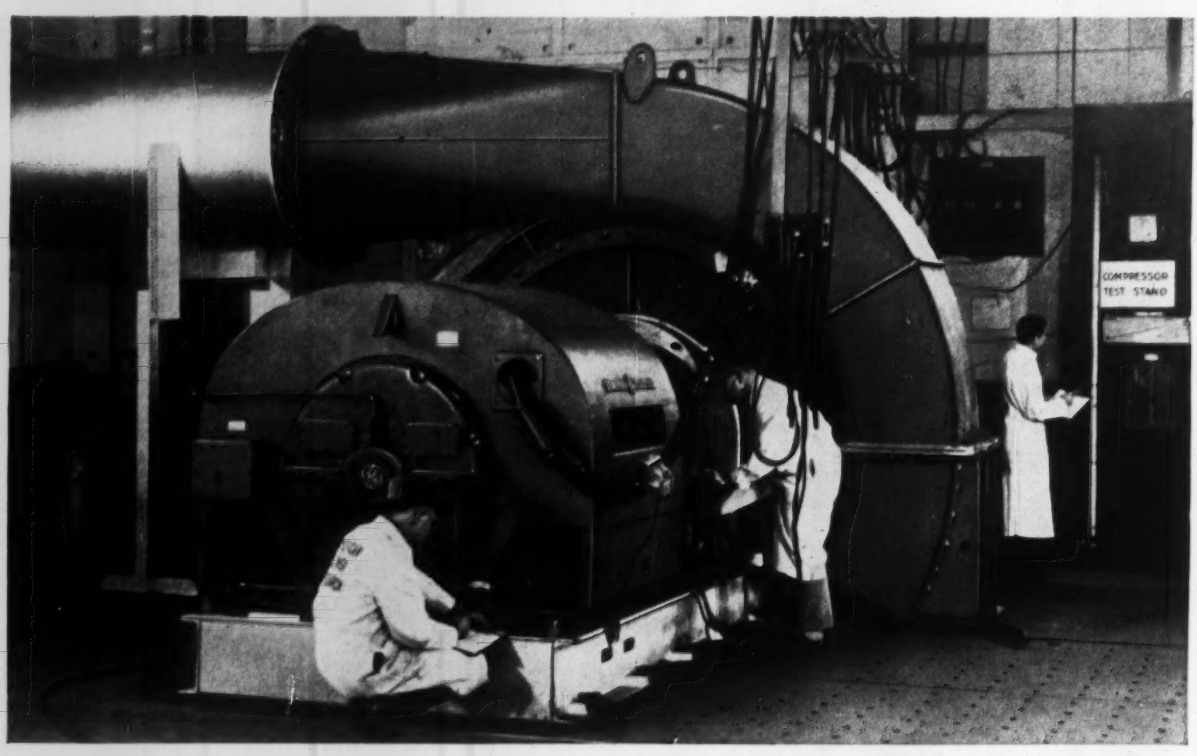
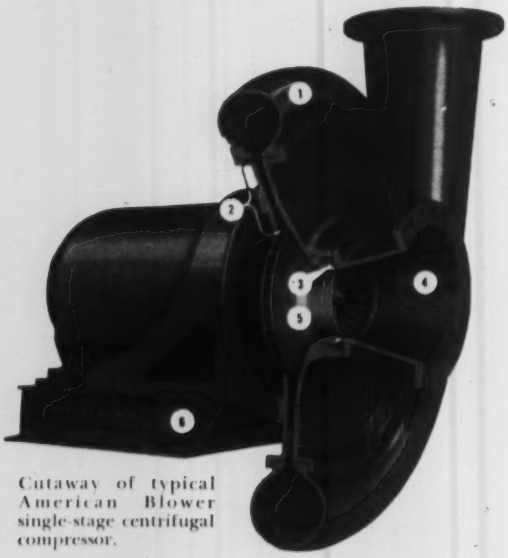
FAFNIR
BALL BEARINGS
MOST COMPLETE LINE IN AMERICA

HERE'S THE LATEST AIR-HANDLING EQUIPMENT FROM AMERICAN BLOWER



LABORATORY TESTED CENTRIFUGAL COMPRESSOR DELIVERS 330,805 POUNDS OF AIR PER HOUR!



Cutaway of typical American Blower single-stage centrifugal compressor.

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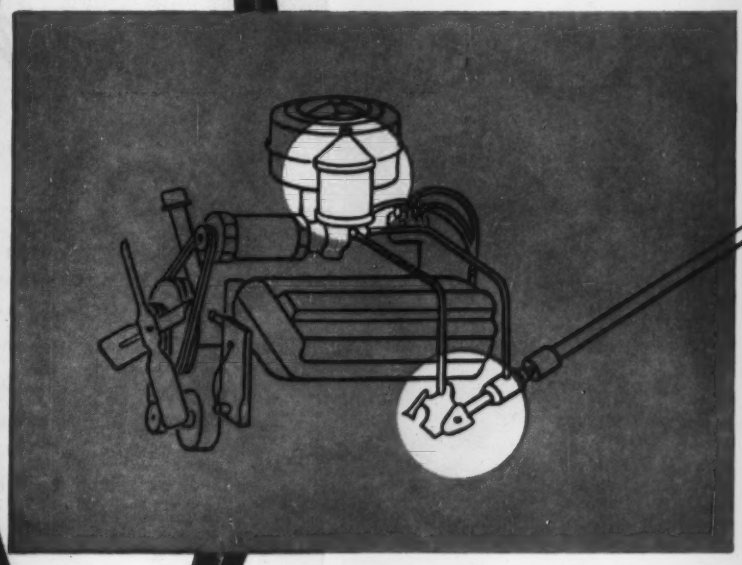

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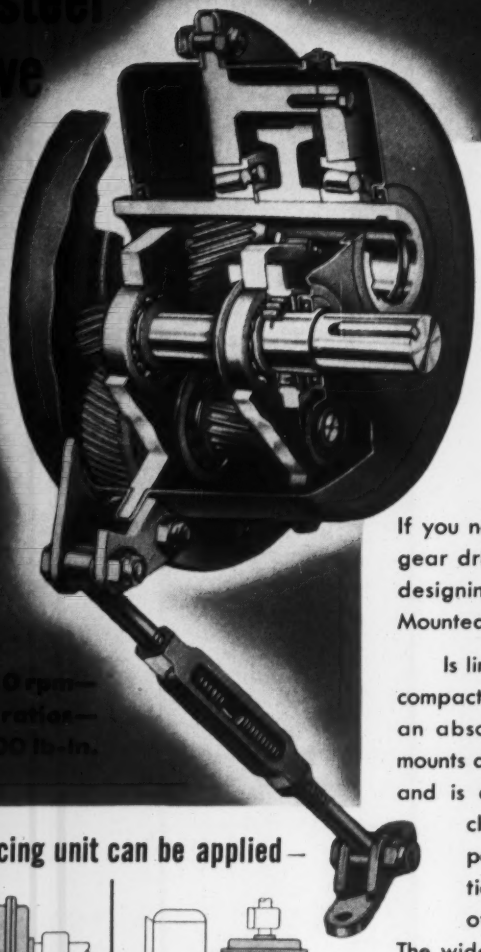

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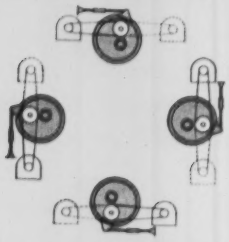
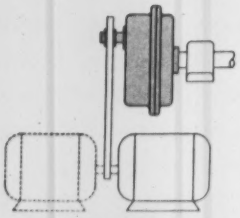
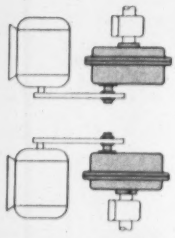


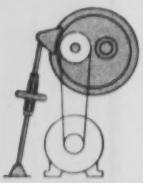
ANY POSITION



MOTOR EXTENDED
—or below the unit



VERTICAL—UP or DOWN



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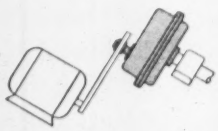

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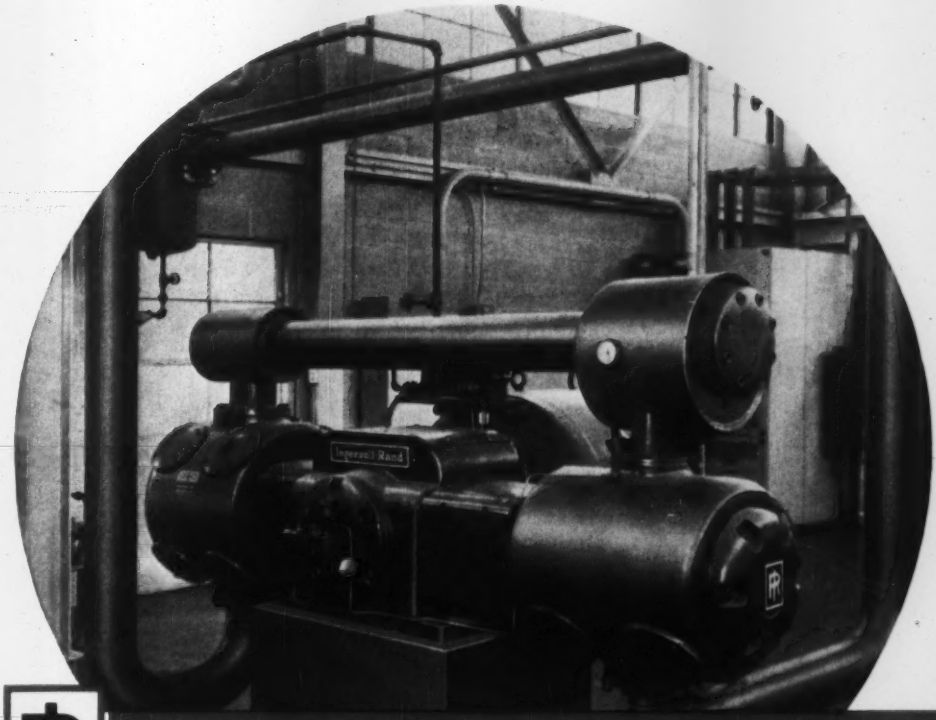

"PHE" COMPRESSOR

serves growing plant-air load at Rotary Electric Steel Co.

WHEN the Rotary Electric Steel Company of Detroit, Mich., increased plant capacity, the existing plant-air supply was also increased by adding the Ingersoll-Rand 100-hp PHE compressor shown above. The extreme simplicity of this installation is obvious at a glance.

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Durability • Air-Cushioned Action • Corrosion-Resistance
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As they're very much interested in finding out, they tag him.

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With Monel, it makes no difference if seals frolic in the salty sea. Or flip-flop around on shore. Or travel from Alaska to Japan, as many of them have! Monel alloy tags proved rugged enough to take this punishment. Some, in fact, remained in good condition *after 12 years on a seal's flipper.*

Do you have a problem involving metals? One in which corrosion, abrasion, high or low temperatures, stresses, or fatigue are causing trouble? Look into the Inco Nickel Alloys. Properties are described in a helpful booklet: *Standard Alloys for Special Problems.* Illustrated with more than 40 case histories. Write *now* for a copy. The International Nickel Company, Inc., 67 Wall Street, New York 5, N. Y.

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APRIL 1957

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Digital information punched into tape . . .

. . . automatically operates this Pratt & Whitney vertical precision hole grinder, ***background***, built for Aircraft Engine Divison of Ford Motor Company, Chicago, Ill. Operator's control panel is at *left*. Pratt & Whitney system of numerical control is believed to be the nearest approach yet devised toward complete automation of machine tools of this type. For further details, see page 356 in this issue.

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MECHANICAL ENGINEERING

George A. Stetson, *Editor Emeritus*
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High-School Science Teaching

In order to maintain its continued leadership in the fields of science and technology, the United States must take some concrete steps to improve the quality of science teaching in its high schools.

It is therefore of interest to note that the American Society for Engineering Education has recently taken steps to do just that—it has come up with a five-point program to improve high-school science teaching and to increase the number of teachers.

Chairmanned by J. F. Downie Smith, Mem. ASME, Dean of the Division of Engineering, Iowa State College, ASEE's Secondary Schools Committee, reporting at the request of the President's National Committee for the Development of Scientists and Engineers, recommends:

1 Science teachers must be encouraged to be better teachers and to teach better science.

2 High schools should have more help to improve teaching techniques, equipment, and curricula in science and mathematics.

3 More and better qualified teachers must be found for high-school science teaching.

4 Good science courses must be made more attractive to more high-school students.

5 Teacher training requirements must be re-evaluated—and certification agencies should emphasize competence in subject matter as well as in education.

To encourage science and mathematics teachers in high schools, the ASEE report calls for elevating the professional and social status of all high-school teachers. Extracurricular loads should be reduced, and assistants should relieve teachers of routine.

Extension courses may help less qualified science teachers become better prepared for their assignments, and industry can help by providing summer jobs for science teachers. Summer programs—such as those sponsored by the National Science Foundation—which bring high-school science teachers back to university campuses are extremely helpful.

As the National Science Foundation points out in its Sixth Annual Report, tomorrow's leaders in science are studying in the classrooms and working in the laboratories of today's secondary schools. Many laboratories use antiquated equipment; students study from outdated texts; too little relationship or continuity exists between high-school and college science. Most serious of all, large numbers of high-school mathematics and science students must be taught by teachers who, through lack of adequate training, are not fully qualified for the task which they conscientiously are trying to perform. In the last analysis, able teachers determine the quality of instruction.

Recognizing the need for the improvement of science teaching, the Foundation launched, in 1953, a series of summer institutes for high-school and college teachers. In 1956 the Foundation sponsored 25 institutes in universities, colleges, and other centers of research widely scattered across the Nation—14 more than in 1955.

These institutes provided some 1300 teachers with opportunities to attend science courses designed especially for them and conducted by competent scientists. Grants supporting the 1956 institutes provided instructional costs to host institutions as well as stipends and dependency allowances to participating teachers sufficient to defray costs of attendance. During 1957, 95 summer institutes, serving 4750 teachers, will be held.

The ASEE report also stresses another important point and one that would go a long way toward improving the situation; namely, that those responsible for teacher certification should be encouraged to "waive the requirements *temporarily* for those qualified in the sciences but lacking some, or in special cases even all, of the presently required courses in teacher training." This would permit the high schools to turn to valuable new sources of science teaching talent—retired engineers and scientists and college teachers. In addition, many industries may share their staff members to help teach science in high schools, a plan already successful in some communities.

This incidentally might afford a wonderful opportunity to ASME members, both active and retired, to assist in bolstering the high-school teaching situation—if and when the required teacher-training courses could be waived. For example, engineers from industry could teach a science or mathematics course for a few hours a week. And many retired engineers could perform a useful community service as science teachers.

The present high-school science teaching problem is not a healthy one and the ASEE and NSF programs are doing much to cure it—but industry, government, engineering societies, communities, and the education system itself must attack the problem with vigor and imagination if the situation is to be remedied. In fact, engineers as individuals can do an effective job in their own communities by working with school boards, the PTA, and similar groups.

Mechanical-Assembly Equipment

Some economic considerations in its development and use

By G. R. Fitzgerald

Director, Process Development Section, General Motors Corporation, Detroit, Mich.

THE General Motors Process Development Section operates as part of the Process Development Staff and is one of four central-office technical-staff groups located at the new General Motors Technical Center in Detroit, Mich. This development section was established mainly to assist the 32 separate operating divisions of General Motors in the development of improved manufacturing techniques. Its relationship with the General Motors operating divisions is similar to that of an independent research group or special-machine supplier.

Currently employing about 400 persons, the Process Development Section was established 10 years ago. Since that time many of the divisions have asked for assistance on assembly problems. A number of these requests have resulted in the design and building of special assembly equipment. While we have not specialized in this field, enough specific and different types of situations have been dealt with to give us a background of experience in this field.

Figs. 1 to 4, showing typical examples of a large group of special assembly machines developed for General Motors plants by the Process Development Section, give some idea of the scope of our work in this field. A machine for a vacuum valve, Fig. 1, is one of the smallest assemblies we have mechanized. Three parts are supplied from vibratory hoppers and the operator loads only a small phosphor-bronze spring. Production output is 2000 pieces per hr. The largest assembly machine supplied to date was developed with the Oldsmobile Division, Fig. 2. It assembles automobile cylinder-head components at a rate of 400 complete assemblies per hr. Fig. 3 illustrates a machine developed in co-operation with the A-C Spark Plug Division for assembly of spark-plug components. Possible damage to the insulator assembly is averted by manual assembly.

A machine developed in co-operation with the Detroit Transmission Division is illustrated in Fig. 4. This machine provides for the assembly of a 12-in-diam turbine assembly, also shown. The 36 turbine vanes are loaded into the sheet-metal shell on individual automatic machines located adjacent to the main assembly machine. This machine provides automatic drilling, reaming, and deburring of rivet holes; the loading and staking of rivets; the spinning of vane tabs to hold the vanes in proper position, crimping of vanes to hold the inner shell in place, and dimensional inspection of the finished assembly.

Contributed by the Management Division and presented at the Annual Meeting, New York, N. Y., Nov. 25–30, 1956, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. ASME Paper No. 56—A-83.

In the development of these machines and the study of many other potential applications for assembly machines, certain conclusions have been reached. This paper reviews some of these with the hope that the discussion will be of assistance to others considering the use of automatic-assembly techniques.

"Automation" Is Only One Solution

Assembly work in most industries has been traditionally manual. Where assembly accounts for a large portion of manufacturing costs, a great many successful attempts to mechanize the system have proved it to be a fruitful field for cost-reduction efforts. This may lead many to believe that "automation of assembly" has promise of application to the solution of an extremely wide range of assembly-cost-reduction problems. However, in its present stage of development, this is far from the truth. Automatic assembly is not always the best solution from an economic standpoint. In fact, experience at Process Development Section has led us to believe that the greatest problems in the use of automatic-

Fig. 1 Vacuum-valve assembly consisting of a conventional-dial index table with hopper feed and escapement units and a Chicago riveter to handle the special rivet which holds the various parts together

assembly equipment are economic rather than mechanical. If the economics of an assembly situation are favorable for automatic assembly, the mechanical problems involved can usually be solved.

There are a number of qualified special-machine builders who have well demonstrated their competence in the development of special assembly equipment. They will accept readily the responsibility of solving the equipment-design problems involved. The responsibility for the economics still rests with the buyer, and to insure wise investment of his tooling and equipment budget, he must be sure that he is getting greatest economic gain with the least added investment. This can be accomplished only by considering many optional plans.

The development of alternative solutions begins with the study and analysis of costs with the existing method, as cost records do not always correspond to factory procedures. The next, and a most important step, involves a thorough and complete study to determine how existing facilities can be used to maximum efficiency. This, we might say, is to develop the best manual method and implies one that is developed through careful analysis by trained methods engineers. It assumes adequate work-place layouts, proper flow of stock, and accurate balance of job-work content between the operators involved. It is not a method arrived at by trial-and-error assignment of job task but rather one developed through film analysis of the operations involved and complete consideration of all job factors.

The data obtained in this study generally indicate the basic direct-labor requirements of the total assembly sequence and each of its parts. Using these data as a base, the engineer explores as many combinations of

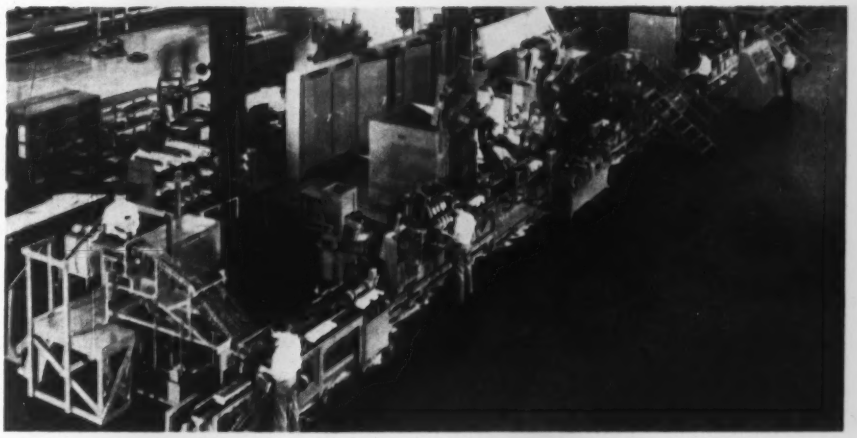

Fig. 2 Assembly machine for the 73 parts required on an Oldsmobile cylinder head. The unit is 137 ft long.

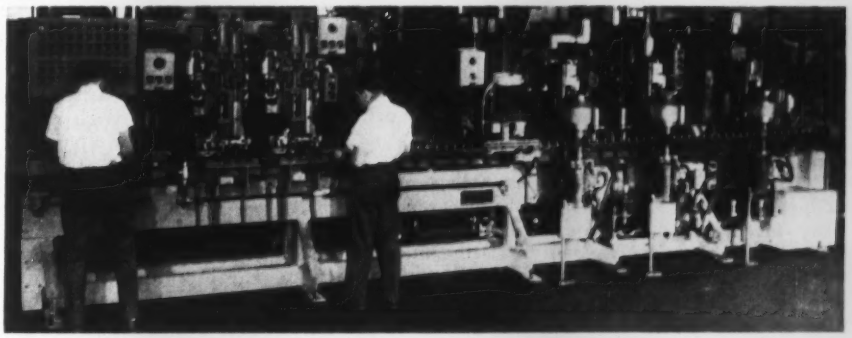

Fig. 3 Machine to assemble the various components of an automobile spark plug. The only manual operation is loading of the insulator assembly.

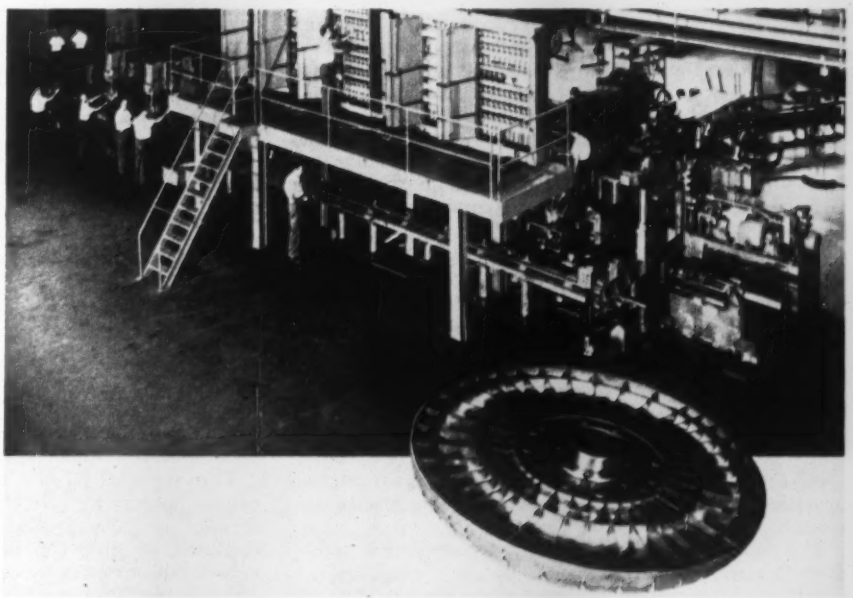

Fig. 4 Turbine assembly for use with the new "Whirlaway" hydramatic transmission. The turbine has a 12-in. diam, and the assembly machine is 75 ft long.

manual and automatic assembly as possible. The various combinations evaluated will generally range from simple improvements and partial mechanization of various operations through total and complete mechanization of the assembly.

The production engineer estimates the manufacturing costs, both direct and variable indirect, for the various methods or combinations developed. He then evaluates these in comparison with the existing method and the best manual method to determine the potential savings involved per unit of production volume. The product of the unit savings and the anticipated volume over the production life of the assembly indicates the total savings that might be expected. In many cases, the obvious solution is so indicated. In others, it may be necessary to review the various plans with the suppliers of assembly equipment to obtain estimates of equipment cost to equate against the total savings.

One fact usually borne out by such studies is that, as the ultimate in mechanization is reached, equipment costs increase at a much more rapid rate than the decrease in labor costs. This explains why some manual operations exist on all of the machines pictured, and why the assembly machines are more truly described as semiautomatic. It also explains why total automatic operation can be justified only with the proper combination of simple operations, high-production schedules, and a product not subject to frequent engineering or model changes.

Certainly a great majority of production situations cannot afford such a degree of automation. The most important point, though, is that we never make the mistake of comparing only existing methods with total automation or only total automation with existing methods. In most cases, there exists between the two a tremendous range of improvement potential that almost any manufacturer can explore to his advantage.

Automatic Operation Can Be Costly

Since so much depends upon an adequate and thorough analysis of manufacturing costs, consideration should be given to other items of added cost that may be incurred with the use of automatic-assembly equipment.

In contrast to manual assembly, which allows sorting out by assembly operators of an occasional bar end, mixed part, die miscut, etc., an assembly machine can be jammed by such items. Even though the number may be small, the effect can be compounded to the point where machine down time can be prohibitive. The addition of manual or mechanical sorting operations, changes in manufacturing procedures, and other means of correction may add to the cost of the components involved.

In spite of the best attempts to design mechanical-assembly equipment to provide maximum flexibility for change, the problem of engineering or model changes can be a costly one. If the assembly is one subject to frequent change, it may not offer good potential for automatic assembly. Or, if certain parts only are subject to change, it may be desirable to establish manual operations for those parts on the otherwise mechanized assembly line.

The allocation of manufacturing-expense items, such as tools, equipment amortization, indirect labor, etc., is usually on a percentage-of-direct-labor basis. The same percentage used on manual assembly cannot be accurately applied in predicting expense items with the use of proposed mechanical-assembly equipment. The direct-labor base on which the manufacturing-expense percentage is applied is usually reduced greatly with such equipment. At the same time, many expense items, such as maintenance, depreciation, etc., are considerably increased. Thus when the economics of the particular situation are borderline, the effect of mechanical assembly on all manufacturing-expense items should be very carefully examined.

Another item worthy of some discussion concerns the length of time required between conception of the assembly plan and putting the equipment into production. Large and complex assembly machines may require a year or more. This amount of time is essential because the limited number of standard-equipment answers to assembly problems means complete engineering, design, and development for each assembly machine. This time factor becomes most important when the completion of assembly equipment must be timed with a new-product introduction or a model changeover. Ample time must be allowed for complete and thorough tryout in both the supplier's and user's plants before full production output can be expected. When the time schedule is very close, it is usually advisable to provide temporary assembly facilities for use until the mechanical equipment has been completely developed.

Coincident with the problem of developing or "debugging" of equipment is the one of training plant personnel in its operation and maintenance. The complete and early training of these people can contribute immeasurably to the success of the equipment involved. A training program may be arranged with equipment supplier so that maintenance personnel can assist in the supplier's plant during the tryout phase. In this manner, they have an opportunity to become completely familiar with the equipment before assuming any direct responsibility for its operation. When complex electrical, electronic, or hydraulic circuitry is involved and experience in one of these fields is lacking in the user's organization, a pretraining period in these fundamentals may be in order for key personnel.

Obviously, design considerations in automatic-assembly equipment is a subject in itself. However, economic considerations are of much greater initial importance to potential users of such equipment; consideration of design details should come only after complete and thorough study of the economics of the assembly situation.

Choice Depends on Economics

Certainly one of the most fertile fields in existence today for manufacturing cost reduction is in assembly. However, the optimum solution to any assembly-cost-reduction problem involves a study of many degrees of automation and thorough analysis of all the cost factors involved. The rate of increase in equipment cost as the ultimate in mechanization is reached is usually more rapid than the rate of manufacturing cost reduction.

Thus we must be sure that we do not overmechanize simply because we believe that "because it is automatic, it must be good." Rather, each situation should be explored to give the best practical balance between equipment investment and cost savings. Or, breaking the complete assembly sequence down into its parts, each part should be equally self-supporting from an economic standpoint.

Offshore Mobile Units—Present and Future

Their number has been increasing steadily and they have been moving into deeper water

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DURING the past few years there has been a rapid increase in world-wide offshore drilling activity. To date, offshore wells have been drilled in the Gulf of Mexico, waters adjacent to California, Lake Erie, Lake Maracaibo, Persian Gulf, Caspian Sea, the Gulf of Paria between Trinidad and Venezuela, and in the South China Sea off Borneo. A platform is currently being constructed in the Japanese Sea off Honshu Island, and the offshore prospects in Cuba, the Bahamas, Pakistan, and off the eastern coast of Venezuela will probably be tested during the next few years. Although the great majority of these wells have been drilled from fixed platforms, the number of mobile units has been increasing steadily since 1949 until, at the end of 1955, there were about thirteen in use. The number in operation should double by 1957. This is a spectacular development when one considers that each unit costs anywhere from two to seven million dollars. Although there has been a wide variation in the design of these twenty-five or so mobile units, they have experienced a fairly orderly evolution from shallow to deep water.

The major problem facing offshore designers is the nature and extent of the forces imposed by a hurricane on a fixed object standing in a body of water. Two other problems are the determination of the soil's capabilities to resist the applied forces resulting from a hurricane, and, of course, the structure's capacity to resist the action of the two equal and opposite forces. Of these the last is perhaps known with the best degree of certainty since, if the loading is definitely established, it is a direct extension of land design principles to cover the case of offshore structures. The second problem of soil capacity is more difficult to solve, particularly from a financial standpoint when full-scale tests may be involved, but it is possible to conduct tests without the benefit of a hurricane. As for the forces resulting from a hurricane, there is only a limited amount of reliable meteorological data available. Worse than that is the fact that there is very little oceanographic information pertaining to the magnitude of such factors as wave heights, storm tides, currents, and wind velocities occurring during severe storms. Even after these factors have been ascertained with a fair degree of accuracy, it is still a major problem to predict what forces a given size wave and wind of a certain velocity will exert on a structure.

Therefore at the present time a wide variation in design exists between all types of platforms which are being used in the same locality and depth of water.

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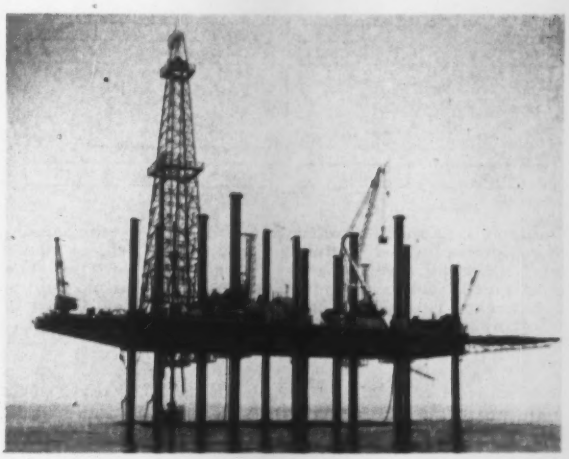


A typical elevated-deck type of mobile offshore oil-well drilling unit after the piles have been driven and the support hull has been sunk to the bottom

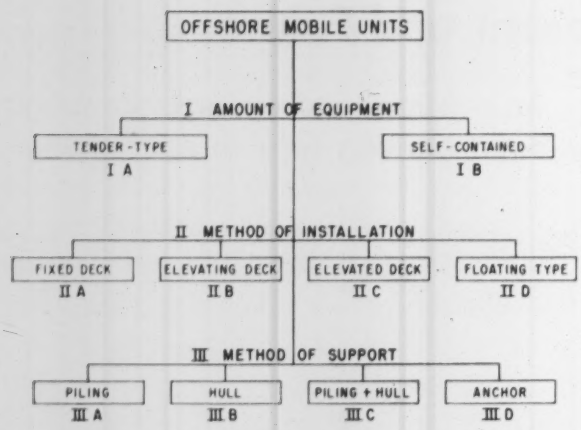
A hurricane of major proportions in the Gulf would provide a test for existing offshore facilities. If the nature and extent of this hurricane were well defined and existing instruments yielded reliable records, it would be possible to make the necessary changes in current design criteria.

Classification

Since a uniform method for classifying mobile units has been presented in detail in a previous paper, only a brief summary will be given here. Also, the advent of coring and drilling ships on the Pacific Coast creates the need for an additional category. The method is summarized in the two charts.

Classification by Amount of Equipment. As with fixed platforms, it is possible to divide mobile units into two classes depending upon how much equipment is located on the unit proper. Except for one recently announced design, all mobile platforms are self-contained in that all drilling equipment, including crew quarters, is built into the unit. The other possibility is to locate only the derrick, drawworks, engines, and perhaps a circulating mud pump on the mobile unit and use it in conjunction with a drilling tender containing the pipe racks, mud pumps, mud pits, mud storage, water storage, crew quarters, and so forth. This arrangement may be called a tender-type mobile unit. Although tender-type mobile platforms have not been utilized to date, a great majority of the world's offshore wells have been drilled from tender-type fixed platforms.

Method of Installation. Another convenient means for classifying mobile units is by their method of installation. They fall into four classes as follows:



Outline classification of offshore mobile units by the amount of equipment located on the unit proper. All drilling equipment including crew's quarters is built into one type. The other type would have only the derrick, drawworks, engines, and perhaps a circulating mud pump on the mobile unit, with a floating drilling tender carrying the rest of the equipment.

1 *Fixed-Deck Units.* During installation these units maintain a fixed relationship between the support hull which is being submerged and the drilling deck. Generally, some type of auxiliary buoyant members, such as pontoons or bearing feet, is used to maintain stability after the support hull is submerged.

2 *Elevating-Deck Units.* This type of mobile platform moves on location with the drilling deck floating, establishes vertical capacity from the soil by means of piling or bearing plates, and elevates the deck to the desired height above water.

3 *Elevated-Deck Units.* The installation of units of this type is similar in every respect to that of elevating-deck units except that the drilling deck remains at a constant elevation during the entire installation procedure. In these cases the deck is carried by a barge which is sunk for bearing-support purposes or by barges or auxiliary buoyant members which are completely removed after installation.

4 *Floating-Type Units.* The recent unitization of anchored ships for coring and drilling work in California coastal waters has necessitated the addition of this category. It applies to all platforms which remain floating during drilling operations.

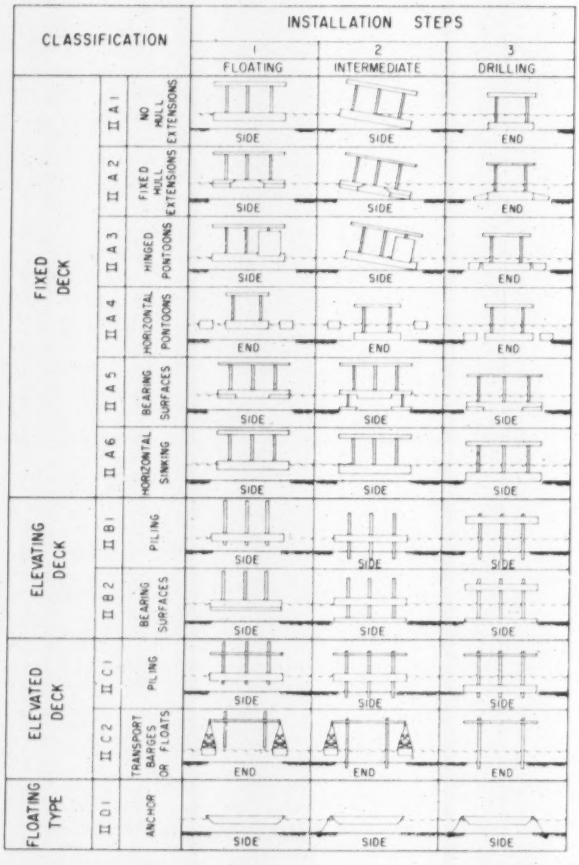
Method of Support. The final means which may be used to differentiate between mobile designs is to divide them according to their method of soil support. The four possibilities are: (*a*) piling support, (*b*) hull support, (*c*) piling plus hull support, (*d*) anchor support. These are self-explanatory; however, it has become difficult to classify exactly some of the intermediate cases such as hull-support units which have mud fins or vertical plates extending into the soil. In these instances it is sufficient to identify only the major means of support.

Related Developments

During recent years there have been a number of world-wide mobile-platform developments not directly connected with the search for oil. These platforms, which are used for purposes ranging from radar platforms to portable docks, have a number of features in common with present-day mobile drilling units, and can be classified using the same system. In some instances these platforms have been installed permanently; however, their method of installation could have been reversed if it were desired to move them.

DeLong Docks. The DeLong docks, which have been used in a number of locations, including Greenland and Venezuela, operate on the elevating-deck principle whereby the floating barge or hull is lifted by means of pneumatic jacks acting on circular caissons. When the dock is in place, the caissons are welded to it, jacks removed, and caissons cut off flush. The dock located in the Orinoco River in Venezuela was constructed in three sections and has a total length of over 1000 ft, depth of 15 ft, and a clearance of 30 ft above the low-water level. This principle was utilized in the design of the Offshore Company's Numbers 1 and 2 units.

DeLong Core-Drilling Platform. This platform was successfully used in the summer of 1954 to obtain foundation data at proposed sites for the Texas Towers radar stations. The platform measured 60 × 250 ft and was equipped with twelve 6-ft-diam piles 120 ft long. The



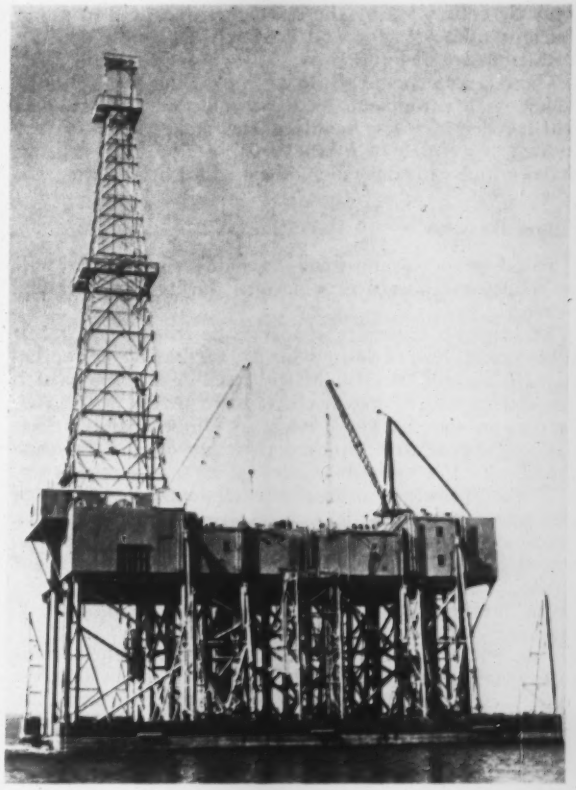
Another classification divides offshore mobile units according to type of deck, method of support, and steps involved in their installation

piles were individually controlled by DeLong pneumatic jacks, each half of which alternately grips the pile by means of an inflatable rubber boot. There were four core-drilling rigs on the platform capable of operating simultaneously.

Texas Towers. The first of five Texas Towers radar stations was installed in 1955 in about 60 ft of water 100 miles off Cape Cod. The platform is triangular in shape and measures approximately 200 ft on a side. It could be classified as an elevating-deck platform since the floating hull was lifted some 70 ft in the air by means of twelve temporary 6-ft piles, each of which was controlled by two DeLong jacks acting in series. After elevation, three permanent piles located in the corners were lowered, jetted into place, and filled with reinforced concrete. The permanent piles are constructed of an upper section 10 ft in diam and 145 ft long, and a lower section 14 ft in diam, 65 ft long with 2-in. steel throughout. After the main piles had been cemented in place, the twelve lifting piles were removed. The platform weathered a very severe winter storm late last year.

British Core-Drilling Platform. It was recently reported that the British have successfully used a mobile core-drilling unit for the purpose of determining the extent of coal deposits which lie under the sea. This shallow-water platform is of the fixed-deck variety and is stabilized during sinking by horizontal pontoons controlled by cables.

Core Drilling From Floating Units. The use of stratigraphic core-drilling ships on the Pacific Coast is closely related to oil-well drilling, but will be discussed later. Also, mobile-foundation core-drilling barges have been operated successfully in the Gulf during good weather in water depths approaching 100 ft. Recently, a newspaper article revealed that one company had drilled core holes from a floating barge in the Gulf to evaluate sulphur deposits.



A fixed-deck unit maintains a fixed relationship between the support hull and the drilling rig. Generally, some type of auxiliary buoyant members, such as pontoons or bearing feet, are used to maintain stability after the hull is submerged.

Current Trends

Based upon the authors' experience, there are a number of current mobile-unit trends which are worthy of mention.

Repeating Designs. During the first five years of mobile-platform development there was considerable variation in both the over-all design and water-depth capabilities; however, in the past year there has been an increasing trend toward repeating certain designs. This is a result of a number of factors. First of all, the number of units is presently increasing so rapidly that there is just not the technical manpower available to prepare and evaluate too many new designs. Secondly, five years of mobile-unit experience have furnished sufficient information to make practical the modification of certain existing units rather than the devising of radically new designs.

Shaped Hulls. Some of the newer mobile units have incorporated streamlined bearing hulls in order to reduce the large wave forces acting on these submerged surfaces. Even though they are located as much as 50 or 75 ft below the water's surface, the forces on the hull alone can account for as much as 80 per cent of the total wave forces.

It is also felt that streamlining increases the resistance of hulls to scouring action resulting from waves and currents.

Multiple Well and Adjustable Derricks. Some of the new designs, particularly the deep water ones, are using multiple-well derricks capable of drilling several wells from one location. This trend is probably the result of two factors, the cost of erecting production platforms in deep water, and the cost of moving a large mobile unit to another location even though it is just a short distance away.

It usually takes one or two days to move a large unit under ideal weather conditions, and, since they cost six to ten thousand dollars a day to operate, the expense of five additional moves to drill six wells becomes significant. Also, weather conditions can result in delays ranging up to a week or more. Weighed against these advantages are the additional cost of directional holes and increased hazards associated with multiple-well platforms.

Drilling Slot. The relationship between the mobile unit and the wellhead jacket is finally coming in for consideration. Many of the earlier units had narrow slots restricting the size of wellhead jacket which could be designed for deeper water. Most of the more recent units have considerably larger slots and some have even eliminated the slot by cantilevering the derrick floor over the side of the rig. To further assist the units in aligning over the well, winches have been installed on some of the mobile units. Cables attached to the well-

head are controlled by these winches and help to guide the unit onto location and hold it there while drilling operations are undertaken.

There is also the possibility of installing the wellhead jacket with equipment aboard the mobile unit such as stiff-leg derricks for handling the jacket, pile drivers located conveniently in the drilling slot, and drilling masts which can tilt over and be used for heavy lifts.

Future Designs

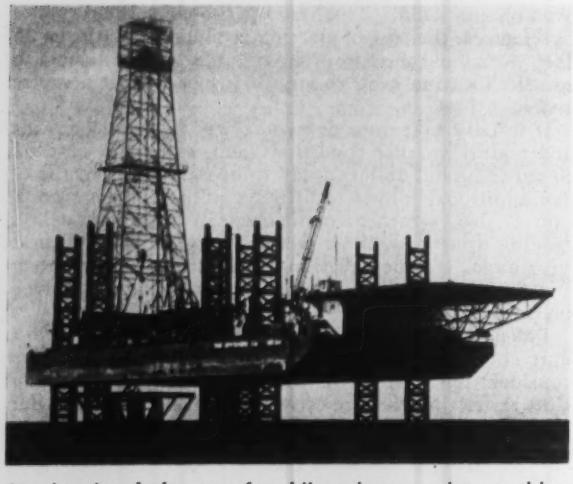
Based upon current trends, a number of features will be incorporated into new designs during the next five years.

Mobile-unit designers appear to be thinking in terms of different types of designs for the various water depths. Certain designs, usually of the fixed-deck type which are less expensive to construct, have proved very satisfactory in the shallower waters. Unfortunately, these designs appear to be limited to water depths less than 70 ft.

The mobile units for greater water depths have evolved designs of probably the greatest diversity, all of which employ expensive jacks of some type which are used to drive piling or elevate the drilling deck which have made the units costly to operate. What effect drilling from floating vessels, which appears less expensive, has on these units only time will tell.

The wide variance in construction cost and the ensuing operational costs has clearly dictated that each mobile unit should be used near its maximum depth range for maximum economy. Any far-sighted development program would show different designs of mobile units operating near their limit in the various water depths.

Shallower Water. Marsh rigs are one class of mobile unit which has had little comment in the literature, partly because they have proved so successful. Many of these units have operated offshore in the shallower waters at rates considerably below the deeper water rigs. A large per cent of the present leases lie in the shallow water, offering an opportunity for a new design which can bridge the gap between the marsh rig and the mobile unit by operating as inexpensively as the former and under the adverse conditions which the latter can resist.



An elevating-deck type of mobile unit moves into position with the drilling deck floating. After piling or bearing plates have established vertical capacity from the soil, the deck is elevated to the desired height above water.

Deeper Water. It is a foregone conclusion that the average depth of water in which exploratory wells are being drilled will increase in subsequent years as will the maximum depth. The water-depth record for the Gulf of Mexico is now about 100 ft and it is about the same in Lake Maracaibo. With the advent of floating-drilling platforms in California, it is difficult to say just what the maximum water depth will be in the next few years, but a good guess would be on the order of 250 ft for conventional mobile and fixed platforms and 600 ft for floating units.

Cost Reductions. The cost of mobile platforms for a given water depth and similar design criteria should certainly be reduced in years to come as more operating experience is available and designs become somewhat standardized. Up to now, there has been a substantial variation in both the design criteria and basic principles utilized with a resulting range of initial costs. As a rule of thumb, all mobile units (excluding drilling equipment) cost in the neighborhood of $40,000 per ft of water-depth potential.

Floating Platforms. The advent of ships in California designed to drill core holes and even test wells is a significant contribution to offshore progress. One group on the West Coast has been drilling core holes since 1954. However, the first public announcement of this type of operation came late in 1955 when Standard Oil of California unveiled their converted LSM core-drilling barge.

Early in 1956, one magazine revealed a similar conversion by Richfield Oil Corporation which had tested a well about 4000 ft deep in approximately 50 ft of water. (The information from test wells will be used to locate a 200-ft-sq earth-filled drilling island in the Rincon area.)

In addition, the Continental, Union, Shell, Superior group has two such barges and Western Gulf Oil Company has one. General Petroleum Corporation and Humble Oil & Refining Company are in the process of equipping similar barges.

With a water-depth potential of 600 ft or more, the floating type of drilling platform should open vast submerged areas heretofore not considered for oil exploration. Its use in the Gulf of Mexico may be somewhat restricted because both the average and maximum oceanographic conditions are more severe; however, it is almost certain that these obstacles soon will be overcome.

Underwater Completions. One of the key problems in the development of floating drilling units, or any other mobile units for that matter, is the design of a technique for completing wells underwater. A great deal of effort is being expended in this direction by a number of oil companies and manufacturers, and a workable solution will add considerable impetus to mobile-drilling activity of all types.

Streamlining. As more becomes known about the exact nature of forces acting on offshore facilities, they will probably be built in a more streamlined fashion from the hull resting on bottom up to the derrick. It was mentioned before that some units are now using streamlined bearing hulls to reduce the tremendous forces acting on these surfaces.

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Free-Piston Engines and Compressors

By J. A. Scanlan[1] and B. H. Jennings,[2] Fellow ASME

The free-piston engine, not too many years ago, appeared to be of significance mainly as an unusual form of air compressor. Current interest, however, shows the free-piston engine to be most important as the compressor-gasifier unit of a gas-turbine power plant. Such a gasifier-turbine combination represents one extreme of the compound engine, with the entire useful mechanical power delivered by the turbine alone. This combination is promising because the turbine, in compact size, provides good starting torque and delivers a smooth and flexible output. The reciprocating-type combustion chamber operating at high pressure develops exceptional thermodynamic efficiency under intermittent temperatures far higher than those which can be employed continuously with present turbine materials. The free-piston engine also can serve as a source of high-pressure high-temperature air for industrial purposes. One application of this nature is related to the rejuvenation of static oil fields by forcing high-temperature high-pressure gas into them. The hot gases fluidize the viscous oils trapped in the sands and make additional recovery of oil possible.

Much material has appeared from time to time on free-piston engines but, as the authors found out several years ago, the literature was widely scattered. Consequently, it was felt that the current growing interest in free-piston engines could best be served at this time by bringing all pertinent references together into a single listing. This bibliography covers a literature search from 1927 to 1956 and is believed to be complete, although it is realized that errors of omission may exist. Most of the references were checked for accuracy as to source and general content; however, this was not possible for all of them.

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(*Continued on page 355*)

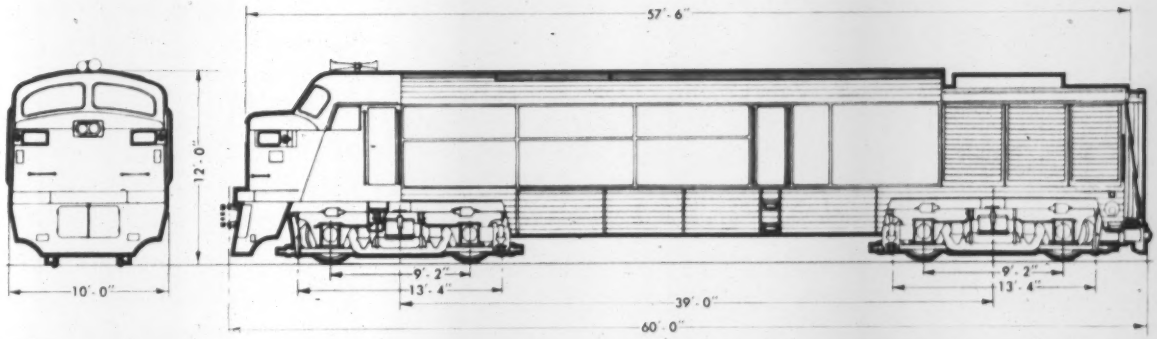

Fig. 1 Elevation of exterior of 1200-hp diesel-electric locomotive for N. Y., N. H., & H. Railroad for high-speed service

Dual-Powered High-Speed Locomotive

New Haven now operating two units on new lightweight passenger train

By Robert Aldag[1] and F. L. Sahlmann[2]

THE decision of some of the railroads to operate the lightweight passenger-train equipment developed by ACF Industries, Inc.,[3] and Pullman-Standard Manufacturing Corporation[4] has required the development of new locomotive types especially designed to meet the resulting demands of performance and service. One of the new locomotive designs has been developed by Fairbanks Morse and Company, the first two units of which are being used as motive power for the New York, New Haven & Hartford Railroad Company's ACF "Talgo" type train placed in service recently.

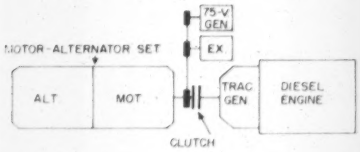

Fig. 2 Diagrammatic arrangement of diesel and motor equipment

High utilization of the locomotives and cars was desired with minimum turn-around time at both Grand Central Terminal in New York City and the South Station in Boston. Specifically, the train was to be turned for the next run at both terminals without the use of a wye or loop track and without uncoupling the locomotive from the train to place it on the opposite end. Hence it was planned to run a locomotive unit at each end of the train, somewhat similar to the European practice of double-ended motor trains.

General data and dimensions of the locomotive are given in Table 1, and general elevation view in Fig. 1.

Table 1 General Data and Dimensions

Model, "Speed Merchant" locomotive	P12-42
Rating, horsepower for traction, nominal	1200
Type, Whyte Symbol	0-4-4-0
AAR Symbol	B-2
Major dimensions, ft-in.:	
Gage	4-8 1/2
Over-all length	60-0
Over-all width	10-6 1/4
Width over cab sheets	10-0
Height over roof sheets	12-0
Wheelbase each truck	9-2
Wheelbase total locomotive	48-2
Distance between truck centers	39-0
Wheel diameter, in	40
Supplies:	
Fuel, gal	725
Lubricating oil, gal	300
Engine cooling water, gal	175
Sand, cu ft	5
Weights:	
Total fully loaded, lb	216000
Total on drivers, lb	110000
Per axle, lb	55000
Performance:	
Starting tractive effort at 30% adhesion, lb	33000
Continuous rated tractive effort (at 23.5 mph), lb	15000
Maximum speed, mph	117
Minimum radius of curvature, ft	212

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[2] Sales Engineer, Locomotive and Car Equipment Department, General Electric Company, Erie, Pa.

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Contributed by the Railroad Division, and presented at the Annual Meeting, New York, N. Y., November 25–30, 1956, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. ASME Paper No. 56—A-68.

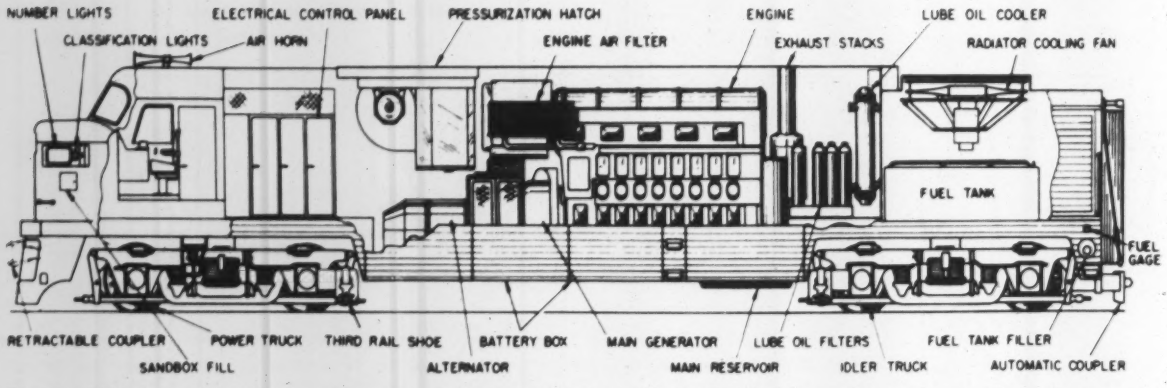


Fig. 3 Elevation of interior arrangement of equipment on new diesel-electric locomotive to power "Talgo" type train

Table 2 Ratings and General Data: 8-Cylinder Model 38D8 1/8 Opposed-Piston Diesel Engine

Ratings:	
Bore and stroke, in	$8^1/_4 \times 10$
Hp—total shaft	1720
Compression ratio—(total volume)	16.1:1
Total piston displacement, cu in.	8295
Idling speed, rpm	300
Operating speed, rpm	850
Overspeed limit, rpm	935–950
Piston speed, fpm	1417
Firing speed, rpm	135–150
Over-all dimensions, in.:	
Height above mounting deck	$108^1/_4$
Length over basic engine	$200^{13}/_{16}$
Weights, lb:	
Engine and sub-base (dry)	33000
Engine and sub-base (wet)	35000
Blower:	
Type—positive-displacement rotary lobe	
Capacity, cfm free air	5820
Injection-pump type:	
Solid mechanical variable beginning	
Bmep at normal hp	96.6

Salient Features of the Design

The single prime mover of the locomotive is an 8-cylinder Fairbanks-Morse Model 38D8 $^1/_8$, opposed-piston diesel engine. Its principal dimensions and ratings are given in Table 2. This engine drives the main traction generator through a flexible coupling. Referring to Fig. 2, an overriding clutch is mounted on the main generator shaft through which a 600-volt, d-c auxiliary generator and a 3-phase, 60-cycle, 440-volt alternator are driven by the engine. A 75-volt d-c auxiliary-control generator and an exciter are V-belt-driven from the overriding side of the clutch. Except for four auxiliary d-c motors by Fairbanks-Morse, the electric equipment was designed and built by General Electric Company.

The diesel engine is operated at constant speed, 850 rpm, and variable load.

A single engine was selected, instead of a combination of main and auxiliary engines, because this arrangement has the following advantages: (*a*) Less first cost; (*b*) less weight; (*c*) less space required; (*d*) minimum equipment required to convert from engine drive to electric-motor drive for third-rail power operation of auxiliaries and train-service generator; (*e*) no duplication or complex consolidation of engine-cooling systems; (*f*) only one engine-cranking operation on each unit for changeover from third-rail to diesel-electric operation; (*g*) the inherent advantage of a single-engine power plant with respect to holding maintenance requirements and cost to a minimum.

Disadvantages of this system center around the possibility of undesirable noise level while the train is standing at a passenger station. Investigation of this matter indicated that this standard engine, mounted in a road-switcher-type locomotive of comparatively open construction, running at approximately no load, 850 rpm, emanates noise which registers 100 decibels (db) at 25 ft from the engine, diminishing to 90 db at 150 ft.

The closed car-body construction and ventilation features described later may reduce this sound level appreciably. The general design and arrangement will permit additional sound-deadening measures if experience indicates such are necessary.

During the layover at Grand Central Terminal between late evening arrival and early morning departure the engine coolant is maintained at a minimum temperature of 125 F by immersion heaters which are connected to the 600-volt d-c third-rail power supply. With this standby maintenance of minimum operating temperatures, each engine may be started immediately when the train emerges from the underground terminal area, and the engines may be set for full-speed full-load operation shortly after the starting sequence, subject to a minimum lubricating-oil-temperature limit switch. The system is designed to obtain complete transfer to diesel-electric operation well in advance of reaching the end of the third rail at Woodlawn, N. Y., 12 miles from Grand Central Terminal.

In contrast to the majority of diesel-electric locomotives operating on domestic railroads, the engine-room space is a pressurized plenum chamber and is used to supply the air requirements of the engine, the self-ventilated main generator, and the air compressor.

Other rotating apparatus in the engine room is self-ventilated and exhausts partially into the engine room. The volume of air supplied to the engine room by a d-c motor-driven blower is 20,000 cfm at 0.5 in.

of water. The purpose of providing a plenum chamber with a small pressure above ambient, instead of the slight vacuum conventionally used in locomotive cabs, is to overcome the inevitable seepage of dust at seams, flashing strip, door seals, and floor grommets. This provision is considered to be highly important in the case of the trailing locomotive which encounters the dust or snow raised from the roadbed by the leading locomotive and the cars.

The engine-cooling system is housed in a separate section at the rear of the main engine room. An access door permits passage through this section to the train. In this section are located the coolant radiators, the inlet shutters, and the d-c motor-driven exhaust fan. For third-rail operation, forced-ventilation-type traction-motor accelerating resistors and associated inlet shutters are arranged at the extreme rear of this section.

Located between the two radiator banks, and shaped to give minimum interference with cooling air flow, is the 725-gal-capacity fuel tank.

Vehicle

The locomotive as a railroad vehicle is basically a streamlined car body on two four-wheel swivel trucks.

The structure consists of main underframe sills which are tied together and to side trusses by the main bolsters and suitable cross bearers. Vertical bending is absorbed by the entire structure acting as a unit. The design, however, is based on the assumption that all buffing forces act on the main sills only.

The structure has two unusual features:

1 The main sills are set on 69-in-wide centers, and have a dropped mid-section to facilitate mounting the engine with the lower crankshaft center line 48 in. above the rail. This in turn permits a roof structure over the engine having an over-all height of 12 ft above the rail.

2 The line of draft at the rear coupler is nominally 19 in. above the rail. The underframe structure is designed to withstand a buffing moment of 12,200,000 in-lb which is higher than in any other locomotive manufactured by this builder.

The trucks incorporate several interesting features. The truck bolsters are supported on coil springs on 97-in. centers; friction-type snubbers operate in parallel with the bolster springs. The swing hangers are suspended from lugs cast on the outside face of the truck frame. It is believed that this is the first time this arrangement has been used on a locomotive power truck.

The truck frames are supported on coil springs from drop equalizer bars.

The truck-frame castings are made without end transoms.

Two third-rail shoe-operating mechanisms per truck are supported from the journal housings of the Nos. 2 and 3 axles by a U-shaped mild-steel bracket welded to the lateral-thrust lugs of the journal-bearing housing, as shown in Fig. 3.

The natural frequency of lateral oscillation of this locomotive, a function of the height of center of gravity and the swing-hanger location and proportions, is approximately the same as that of conventional streamline locomotives. The displacement of the center of gravity from the plane of the track center line as a result of centrifugal force or other lateral disturbances, is essentially a function of height of center of gravity, mass, spring centers, and spring-deflection rates. A comparison of these factors is given for this locomotive and a typical conventional streamlined locomotive in Table 3.

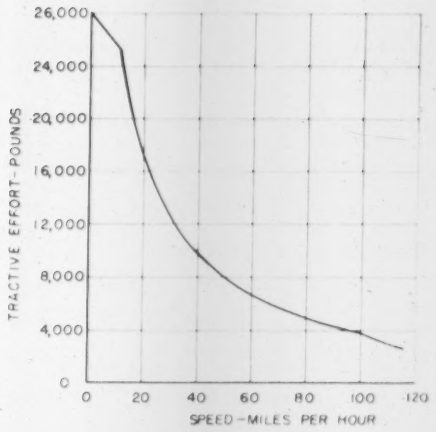
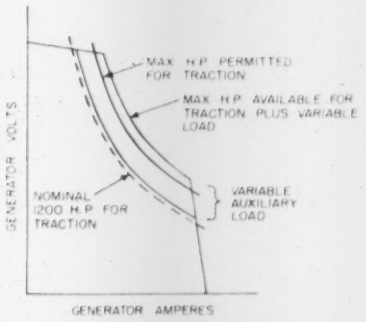


Fig. 4 Locomotive speed-tractive effort characteristic curve


MAX. H.P. PERMITTED FOR TRACTION
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NOMINAL 1200 H.P. FOR TRACTION
VARIABLE AUXILIARY LOAD
GENERATOR VOLTS
GENERATOR AMPERES

Fig. 5 Two generator characteristics

Table 3 Comparison of Factors Affecting Lateral Displacement of Center of Gravity

	Speed Merchant	Conventional
Center-plate load and bolster weight, approximately, lb	155000	177000
Height center of gravity of sprung mass above plane of bolster springs, approximate, in	24	40
Spring centers, in.	97	60
Spring rate, one side, lb/in.	9700	10350

It is anticipated that the lateral stability obtained by the downward shift of center of gravity and the increase in the spring centers will result in substantially less lean or roll of the car body with respect to the trucks, thereby reducing lateral displacement of the center of gravity materially. Thus higher speeds will be permissible on curves without reducing the customary margin of safety with respect to overturning.

The trucks are equipped with clasp-type brake rigging for use with composition-type brake shoes. The average coefficient of friction of the brake shoes will produce a retardation rate of about 1.5 mph per sec when a total brake-shoe force equal to only 35 per cent of the total weight of the locomotive is applied in a full

service application of the brakes. This moderate brake-shoe force permits the use of brake cylinders and levers of reduced size and weight as compared to conventional equipment.

The air-brake control equipment utilizes one train-line pipe for control and air supply. An estimated time of 3.5 sec is required to complete a full service application throughout the length of the train; an estimated 2 sec are required to complete an emergency application.

Electric Equipment for Propulsion

The traction generator is a conventional separately excited, shunt-field machine with a series starting winding for cranking the engine from the battery. The means of excitation differs radically from that used on conventional diesel-electric locomotives, since in this application the diesel engine must operate continuously at full rated speed to provide nominal 440-volt 60-cycle power for train auxiliaries. This means that the traction generator operates at 850 rpm and all control of traction power must be provided by field control through the amplidyne exciter.

Two GE-752 motors are used for traction purposes on each locomotive. This is a standard motor for diesel-electric-locomotive application, and is used on the 10 rectifier locomotives now operating on the New Haven Railroad.

Fig. 4 shows the speed-tractive-effort characteristic of each locomotive, based on 1200 hp input to the generator for traction. The continuous tractive effort is 15,000 lb at 23.5 mph, corresponding to 13 per cent adhesion on the two driving axles. The motors are always connected two in parallel, full and shunted field, for diesel-electric operation. The equipment is suitable for operation at speeds up to 117 mph.

During third-rail operation, automatic resistor control is provided for smooth acceleration in 12 steps under control of a current relay. Although notching is automatic, it is under the control of the engineman, who may vary the rate of acceleration with the same throttle handle used for diesel-electric operation. While this type of equipment is commonly used on multiple-unit cars operating on third-rail power, this is believed to be its first use on road locomotives in the United States.

Since a single engine drives both the traction generator and variable-load alternator, two generator characteristics, Fig. 5, are used to utilize maximum available power for traction. Note that both are in excess of the nominal or rated value of 1200 hp.

Performance calculations of the two locomotives propelling the five-car train indicate that on level track with the nominal 1200 hp available for traction in each locomotive, a speed of 80 mph will be reached on level track in 4.45 min or a distance of 4.2 miles. The average speed of nearly 60 mph during this acceleration indicates that this train will be capable of unusually fast schedules in frequent-stop service, based on the nominal power for traction. With train-service loads at the normal level, the additional power available for traction will improve further the attractive performance characteristics of the train.

Train Power Supply

Electric apparatus on the train, such as fluorescent and incandescent lighting, heating, air conditioning, ventilating motors, and so on, is designed for operation on 3-phase, 60-cycle, 400-volt power. The carbuilders' selection of standard voltage and frequency for this equipment is obviously desirable from the standpoint of standardization, cost, and availability. The locomotive builders are confronted, therefore, with the necessity of supplying nominal 60-cycle power for the train when operating from either third-rail or diesel-electric power. When diesel-driven, however, the alternator runs at 850 rpm, with a corresponding frequency of 56.7 cycles. To operate inductive devices rated at 60 cycles on this reduced frequency, the nominal voltage of the a-c system was dropped in proportion to the frequency—from 440 to 415 volts—for both third-rail and diesel-electric operation. A 600-volt d-c motor is used to drive the a-c generator at 850 rpm on third-rail power.

Locomotive Auxiliaries

The locomotive auxiliaries consist of a radiator-and-resistor-cooling-fan motor, two traction-motor blower motors, a pressurizing-fan motor, and an air-compressor motor, all of which are 600-volt, d-c machines. When operating from third-rail power, they are connected directly. When operating from diesel-electric power, these motors are fed from the large d-c machine attached to the alternator which acts as a 600-volt generator with constant field. Thus this machine does double duty, since it also acts as a drive motor for the alternator when running from third-rail power.

Power-Source Transfer

With the train operating on third-rail power, the motor-alternator set will be running at between 850 and 900 rpm, and the throttle will be in one of the operating positions for third-rail propulsion. The traction motors will be in series on full field. Preparatory to changing over, the diesel engine is started by cranking with the main generator running as a series motor from the 64-volt battery. After the engine has started and operated briefly at idle speed, it is brought up to its normal operating speed of 850 rpm and is then ready to take load.

The engineman then moves the throttle handle to idle and throws a transfer switch from third-rail to diesel-electric position. This disconnects the large d-c motor from third-rail power. When the speed of the motor-alternator set equals the engine speed, the over-riding clutch engages. The d-c machine, the alternator, the exciter, and the auxiliary generator are then driven by the engine.

Power and auxiliary equipment circuits are changed by a multicontact, power-transfer switch. Circuits are interlocked so that no change can take place until the throttle has been moved to the idle position. This insures a smooth transfer under the control of the engineman. As the throttle is advanced after transfer, it controls the excitation of the main generator.

When the train departs from the third-rail zone, the engineman's transfer switch is then moved to a position which retracts the third-rail shoes.

In changing from diesel-electric to third-rail operation, essentially the reverse of the foregoing procedure is followed. The locomotive is believed to be the first of its kind. It is essentially a diesel-electric motive-power unit and headend power-supply unit for a high-performance train equipped for the versatility required to perform all functions on two sources of power of very different characteristics.

A Nonintermittent Film Projector . . .

. . . which compensates for the continuous motion of the film by means of two rotating and tilting mirrors

By Otto Wittel[1] and Donald G. Haefele[2]

Apparatus and Optical Division,
Eastman Kodak Company, Rochester, N. Y.

THE nonintermittent or continuous-film projector has been the dream of the motion-picture engineer from the start of the industry, and a great deal of time and money has been spent on projectors of this type. Although nearly 1100 patents have been issued on this subject, the German-made 35-mm Mechau projector was the only one to succeed commercially prior to the demands of television. Lack of fruition in all this work was due mainly to the fact that this continuous type of projection offered little, aside from complexity, over the well-made intermittent projector.

TV Creates Need

With the advent of television, an added need for nonintermittent projection was born. The storage characteristics of television-camera tubes placed a serious limitation on the quality of the picture televised from an intermittent projector. With the advent of color television, the advantages of nonintermittent projection became even greater.

The problem was to develop a 16-mm film projector that would permit the use of the flying-spot scanner tube as a light source for the broadcast of a color television signal. The advantage of this type of illumination and projection is that there are no complications associated with the registration of the three-primary-color images.

The Flying-Spot Scanner

The flying-spot scanner is a cathode-ray tube that generates a white stationary raster on its face by scanning the phosphor in a line pattern with an electron beam—much as any home television tube does. This raster is of the same proportions as a frame of 16-mm film. A complete raster is generated 30 times per sec and is imaged by a system of lenses on each frame of film being projected. There the light is filtered by the image on the film, and the portion that is transmitted passes on to phototubes which generate electrical signals. Such a scanning tube has no storage characteristic; therefore, the only time available for advancing the film, if an intermittent film motion is to be used, is the retrace time between the end of one scanning period and the beginning of the next, approximately 0.001 sec. It is only during this short time that no picture information is being transmitted.

[1] Superintendent, General Development.

[2] Design Engineer.

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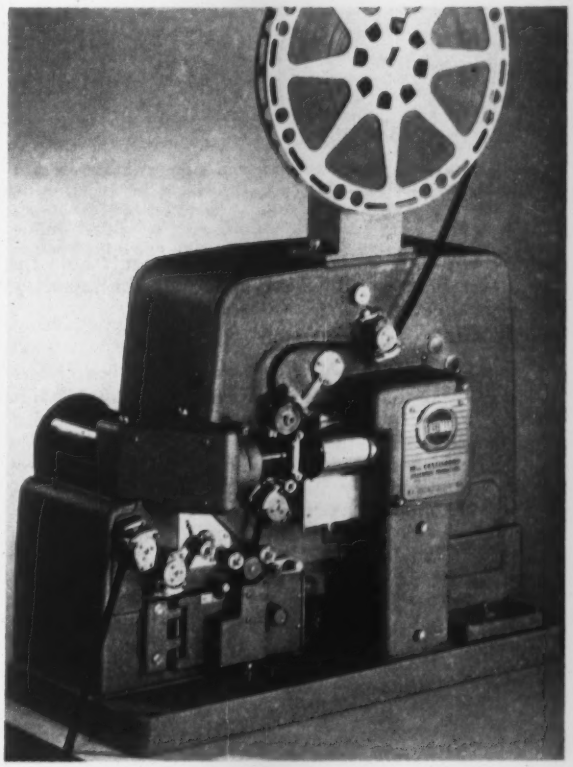

Fig. 1 Production model of the final design for the nonintermittent projector

This flying-spot-scanner type of projection had been applied experimentally to 35-mm Kodachrome slides for some time; however, the step to cine projection in the conventional intermittent manner depended on ability to advance the film in the available time of 0.001 sec. The forces involved in this highly accelerated type of pulldown, some fifty times as great as in normal projection, were so discouraging that our attentions were turned to the continuous or nonintermittent type of projector, shown in final form in Fig. 1.

The Nonintermittent Projector

The first model built by the Eastman Kodak Company was the original "breadboard" model shown in Fig. 2. Although obviously crude, it demonstrated that

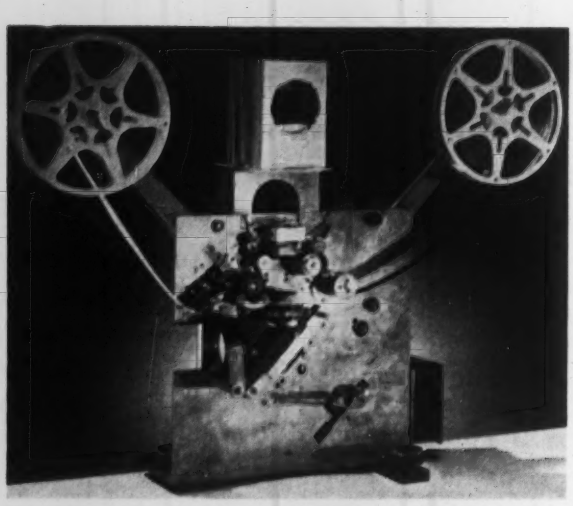

Fig. 2 Breadboard model used for experiments in developing the nonintermittent projector

a simple two-mirror optical compensator could hold the image stationary while the film moved continuously.

How It Works

Investigations and experiments with this breadboard model showed that, to be practicable, the final design would need an optical system of extremely high aperture. Consequently, the optical system shown in Fig. 3 was designed with an aperture of f/1.6, capable of passing approximately 10 times as much light as any 16-mm continuous projector known to us at the time. We were convinced that this amount of light would be needed in view of the low light output of the source and the density of the films then known to exist.

In Fig. 3 the light source or flying-spot scanner is at the lower right; the collimator lens which is directly over the scanner is a focal length away so that the light above it is parallel. The compensating mirror, located above the collimator lens, tilts to direct the stationary raster of the scanning tube toward the moving piece of film; the objective lens is placed a focal length from the moving film. The remaining optics, collector lenses and a mirror, relay the image of the diaphragm in the objective lens to the photoelectric cells. Two dichroic beamsplitters and three filters separate the light into three primary colors. Thus, signals from the photoelectric cells, properly amplified and corrected, can now control the scanning of a receiver equipped to show a color picture.

Prototype Development Problems

The step from the breadboard model to the prototype was a large one involving many considerations.

On the basis of previous experience, it was decided that a commercially acceptable projector would allow a frame-to-frame variation in image position not greater than 0.0005 in. vertically and horizontally measured at the film.

Since a continuous-film projector matches a moving optical compensator (in this case two mirrors) to a moving frame of film in an attempt to make the image stand still, the film drive, the optical compensator, and any drive connecting the two are all sources of error. In addition, there are optical errors resulting from lens aberrations, particularly distortion, which must be minimized.

An additional problem is that introduced by shrinkage of the film, and the adjustment of the moving optical compensator so that it would match the linear speed of the film regardless of its shrinkage.

Since the total quantity of projectors that we could reasonably expect to manufacture and sell was low, the individual parts had to be designed for a moderate tool cost per projector. The design utilized only three basic methods of fabrication, those required to produce sand castings, short-run stampings, and parts turned on hand lathes.

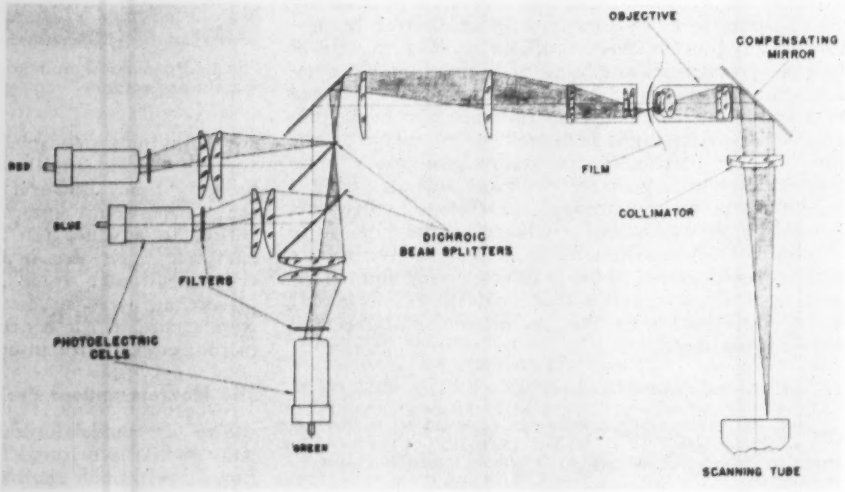

Fig. 3 Optical system of nonintermittent projector shows the path of illumination from the scanning tube when used with color film

Optical System—Mirrors

A line sketch of the basic mirror-tilting mechanism that directs the image of the stationary raster of the scanning tube to the moving film is shown in Fig. 4. The mirrors are driven rotationally by means of the drive pulley, which is driven from the camshaft. While one mirror is in the light beam and is directing the image of the raster to the film, the other mirror is out of the light beam. Its rocker arm is in contact with the "return" side of the cam, where it is regaining its position so that it can follow the next frame of film. The first essential in this movement is a flat mirror properly mounted with its reflecting surface exactly perpendicular to a line through the centers of the controlling bearings.

The mirrors themselves, which have plano reflecting surfaces and are semicircular in shape, are placed together so that they form a complete circle mounted on a drift shaft. These mirrors have a 3-in. radius and a thickness of 0.281 in. at the center, tapered on the backs to 0.060 in. at the periphery. They are flat within one wavelength of light. The method of manufacturing these mirrors was a development project in itself because the finished mirror is quite thin and may bend out of tolerance of its own weight if not properly supported. Even cements with a shrinkage of only 2 per cent have a tendency to warp the mirror if the curing is too rapid.

The Film-Shrinkage Problem

The movement of the film is complicated by the necessity of handling various shrinkages. It is a twofold problem. Of first concern is the matter of physically moving the film across the gate at a uniform speed; it was essential that a sprocket be designed that could change its pitch on signal to accommodate any shrinkage within the range to be encountered. At least two teeth must be in contact with the edges of successive perforations at all times so that the withdrawal of one tooth will not result in a film jump.

A tension roller is mounted on a spring-pressed arm, Fig. 5, so that it is forced to the right and takes a position indicative of the length of the section of film threaded between the control sprocket and the drive sprocket. As the tension lever moves, the drum pivots from side to side, thus increasing or decreasing the radius at which the teeth engage the film. Since the teeth are radial, this increases or decreases slightly the pitch of the sprocket at the side where the teeth are in full engagement with the film. At the top of the sprocket, the pitch is not affected, and consequently the teeth at this point are able to enter the perforations in the film without interference. As the tension roller moves with a variation in shrinkage, both barrels of the objective lens are repositioned to effect a change in the focal length of the lens without disturbing its focus. With the mirrors tilting through a constant angle, a change in the focal length of the lens affects the length of the optical lever arm through which the mirror angle is effective; thus the throw of the image is altered. If the ratios of the arms are chosen correctly, the change in the throw of the image matches the change in dimension of the film. In this manner, when the projector is once adjusted to a standard piece of film, it will maintain its adjustment throughout any reasonable variation of shrinkage. This feature is most important because it makes possible the use of all existing films without any regard for shrinkage.

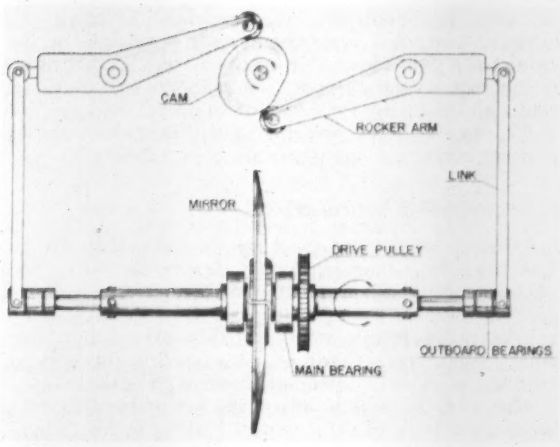

Fig. 4 A complicated mirror-tilting mechanism prepares one mirror for following the next frame on the film while the first mirror is in use

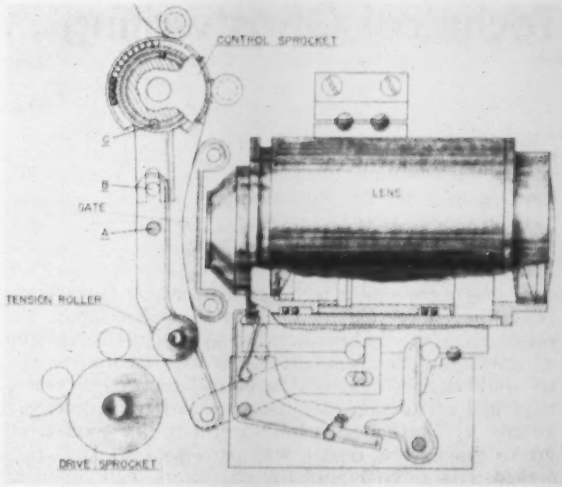

Fig. 5 Film path and shrinkage control. The tension roller is mounted on a spring-pressed arm in such a way that it is forced to the right and takes a position indicative of the length of the section of film threaded between the control sprocket and the drive sprocket.

Summary

In this paper an attempt has been made to describe the development and mechanical design of a specific item in the optical industry. While the projector is not necessarily typical of all jobs in this particular field of design, the accuracy and tolerances required to control moving optical systems are representative. The satisfactory performance of any optical-mechanical device can be attained only by a continuing study of dimensions and tolerances and a thorough analysis of the effect of each on the performance of the final product.

Technical Ghostwriting . . .

. . . A Ghost's Point of View

By Christian K. Arnold

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A FEW years ago, a technical editor at a Government laboratory suggested to the coauthors of a report that the material should be reduced to an article. The authors agreed the information deserved wider distribution than it would receive through an official report but averred they had neither the time nor the ability to draft such an article. Rather than have a potentially good article go to waste, the report was converted to an article, signed with the names of the coauthors, and submitted to them for approval. They were reluctant to permit the use of their names, not because the article was poorly written or contained inaccuracies but because it seemed unethical for them to sign an article they had not written.

Is Technical Ghostwriting Ethical?

Certainly! Ghostwriting is not only ethical but also commendable! Although the practice is not new in literary works—some think that Shakespeare's plays were written by a ghost—technical ghostwriting, for all practical purposes, is new. In fact, technical editing itself is so new that it is often not even considered a separate, distinct profession. Despite the youth of his calling, however, the technical editor has become an important member of the staff of almost every research, development, and testing organization in the country. And, wherever you find him, part of his job will be that of ghostwriting.

Because the practice of technical ghostwriting has spread so rapidly, policy has not always kept pace with it. In some organizations, the problem is avoided at the highest policy-making level and must be faced anew with each ghosted piece of writing. Technical editors generally agree that ghostwriting is usually desirable and often absolutely necessary, but are not certain that it is ethical.

The belief that technical ghostwriting is unethical is obviously based on the assumption that the name at the beginning of an article confers credit for the actual writing of it. Authorship has another function, however; it fixes responsibility for the material written about. This function is stated explicitly in our libel laws. In a work of fiction, there is generally no conflict in this dual function. The person who writes a story is also responsible for whatever factual information it contains. Here, too, the writing itself is all-important, the factual information being only secondary or incidental.

In a technical article, however, the relative importance of the two functions of authorship is reversed. The information contained in the article is the sole justification for it. The writing as such becomes really important only when it is so inept that it contributes to misunderstanding or provides for no understanding. Seen from another point of view, the fiction writer, in greatly oversimplified form, is selling his ability to string words together to create a particular effect. The author of a technical article is "selling" his ability to gather data, to analyze it, to synthesize it with the common body of knowledge, and to put it to use in the service of man—in other words, his ability as a scientist or engineer.

The Meaning of Authorship

If a division of the functions of authorship should occur in the parentage of a work of fiction, authorship should, and does, confer credit for the writing. It is not uncommon for an author to admit graciously in a preface that the story was suggested to him by a particular person. No violation of ethics has been committed. If, on the other hand, the functions should be divided in a technical article, authorship should fix responsibility—or confer credit, if you wish—for the information. It is the information in this instance that is important, not the writing. Einstein's theory is his, regardless of who tries to explain it to us, and the theory is more important than the writing.

But is it wrong to divide the functions of authorship in this fashion? To conclude that it is, is to turn our backs on the system responsible for America's position as technical leader of the world. Suppose an inventor needs a working model of a machine he has designed based on a newly discovered principle. If he lacks the machinery, time, or skill to fabricate his model, must the invention go begging? Of course not. He simply hires a competent machinist to construct the model for him. When the patent is granted, it is issued to the inventor, not the machinist, regardless of how important his part in constructing the machine has been. No ethical wrong has been committed, provided the machinist was paid adequately for his work. Specialization is inherent to our system. There is no law, nor even tradition, requiring the inventor to do his own machine work. In a very real sense, the position of the technical ghostwriter is analogous to that of the machinist.

Is Coauthorship Indicated?

Perhaps, then, coauthorship is indicated. In the first place, coauthorship would elevate the writer to a position out of all proportion to the services rendered. Second, such an arrangement would be patently unfair to the many people who probably played important roles in gathering, testing, and analyzing the information but who were not honored through authorship.

The days in which important scientific discoveries were made by a tinkerer working alone in his cellar at night are gone. Today, contributions to our knowledge of the physical world are made through the teamwork of a group of specialists working under the direction of a

project leader. At least, this is the way such contributions are made in an organization large enough to have a technical writer. This "team" might easily include scores of people: Specialists in various branches of science, engineering, and mathematics; technicians; machinists; electricians—even an editor. The project leader who must co-ordinate the work of this group is as much an administrative officer as he is a research scientist. The end product of the project—which may take years to complete—is usually a report prepared by an editor from a rough draft assembled by the project leader from the data collected, to a large extent, by members of his team.

Who is to sign this report or an article based on it? Authorship considered as a means of giving credit for the wording of the report would indicate the editor. But his share in the final product, from any point of view, is a small one indeed. The idea of coauthorship, to be fair to all who had contributed significantly to the project, would lead to a list of credits rivaling those that precede a movie or appear on a playbill. Authorship considered as the fixing of responsibility for the information clearly indicates the project leader in this hypothetical but typical situation.

Once the idea that authorship fixes responsibility for the information contained in an article is accepted, the answer to the question of who should sign the article becomes clear: The article should be signed by the person to whom the reader should write to find out more about the subject. This person is seldom the technical writer.

The Value of Technical Ghostwriting

If technical ghostwriting is ethical, it is also commendable. It is commendable for two very important reasons: It results in (1) better communication and (2) greater organizational efficiency.

It is not enough simply to make new discoveries; such discoveries must be communicated to others before they can be put to work most effectively. In this day of specialization, it should be unnecessary to belabor the fact that a specialist in technical writing can produce a better communication than can an engineer or scientist with little training or experience in writing. Yet the very scientist who is reduced to "you know what I mean" in attempting to explain a not overly complicated bit of reasoning is apt to maintain that technical editors and writers are basically unnecessary. It is not uncommon, however, to see reports so badly written that it is impossible for the reader to understand them.

What is often not understood is that good functional writing is an exacting skill achieved through hard work and grueling experience and that such skill is not compensated for by knowledge of the subject being written about. Because of this misunderstanding, good ideas and important information are lost every day through inadequate and ineffective presentation.

Actually, we should turn as naturally to the trained technical writer when we have a communications problem as we do to an electrical engineer when we have an electrical problem. And we should no more expect the mechanical engineer to turn out a top-notch piece of writing than to expect him to solve our electrical problems for us. Scientists and engineers just don't have the required training and experience, by and large. In addition, the scientist who will spend months painstakingly correcting the slightest flaw in his testing equipment often seems not to have the writer's patience to work over draft after draft until a satisfactory piece of writing is obtained. This point is important. An editor of a large New York publishing firm puts it this way: "There is no such thing as good writing; there is only good rewriting."

Many technically trained people who readily concede the advantages to be gained in such things as conciseness, clarity, and understandability still balk at having their material worked over because they believe inaccuracies creep in during the rewriting process. Actually, quite the opposite is true. There is hardly a single technical editor to whom the detection and correction of errors are not an almost daily occurrence. In fact, this may easily be the most important service performed by the editor.

Importance of Presentation

About three years ago, it was reported that the members of President Eisenhower's Cabinet, in reviewing the President's economic report to Congress, questioned some of the apparent conclusions to be drawn from it. It was discovered that the economists who drew up the report had meant just the opposite of what the report seemed to say. A thorough revision by professional writers was necessary to insure that the report actually stated the President's policy. Such experiences are also common among technical editors and writers.

In addition, revision by an editor or writer forces the author to give the report or article a check that would not otherwise be made, since the reworked draft must be reviewed. The original checking is apt to have been perfunctory; after all, the author had written or dictated it himself, and he knew what was in it. This second reading is more thorough—who knows what an editor might have done to it? The result is a piece of writing improved not simply in understandability and fluency but also in accuracy. And inaccuracy is the cardinal sin of technical writing.

Efficiency is gained in two ways. First, a qualified technical writer can turn out an acceptable article faster than most scientists can produce an unacceptable one. An engineer who is smoothly efficient and completely at ease in his laboratory will suddenly become immobilized when faced with a typewriter. A common question is: "Where do I start?" And, because he is not sure of himself and has little training and experience for the job before him, he is likely to stall and procrastinate. The professional writer will face the job as confidently and as efficiently as the engineer faces the job for which he is especially trained.

Second, the engineer, freed by the technical editor of a chore for which he has little liking, is able to direct his energies at solving just those problems for which his training qualifies him.

Summary

Technical ghostwriting is a sound, ethical practice once it is accepted that writing is a professional skill acquired only after years of special training and hard experience. It is as foolish to deny ourselves the services of this specialist as it is to reject the services of an acoustician, a chemist, or a specialist in hydrodynamics.

Fire Safety of Engineered Timber Construction

Timber construction affords considerable fire resistance and strength, salvage value is high, and there is a tendency in a fire to support the masonry walls rather than to displace them laterally and cause their collapse

By Frank J. Hanrahan, Mem. ASME

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UNTIL relatively recently, most timber structures were designed empirically or by "rule of thumb." The past quarter century has brought advancements in several fields which have made engineering with wood common practice today. The more noteworthy are:

1 The establishment of stress grades in the various species of structural lumber.

2 The development of new adhesives and proper laminating and fabricating techniques.

3 The establishment of lumber inspection services for properly identifying lumber stress grades.

4 The development of more efficient mechanical fastenings and accurate allowable working loads for them.

5 The establishment of an engineered timber-fabricating industry with the technical and commercial know-how for designing, fabricating, and erecting frameworks of practically any type, size, or shape to meet the designer's demand.

All of these have been influential in bringing about the present firmly established position of engineered timber construction in the American scene. Today most of it is one or two-story construction and it is being used extensively for structural framing of commercial, industrial, military, agricultural, educational, recreational, housing, medical, transportation and other buildings, bridges, towers, wharves and docks, ships and many other types of structures. The accompanying photographs (Figs. 1 to 3) collected from various members of the American Institute of Timber Construction illustrate some current types of engineered timber construction. Today, clear spans run up to about 300 ft in timber trusses and glued laminated arches, and in excess of 100 ft in timber beams. Wood roof planking as thick as 4 in. and glued laminated timber cross sections as large as 22 × 95 in. are used.

Engineered timber construction may be in the form of heavy timber construction or construction having member sections smaller than required for the former. The current National Board of Fire Underwriters' National Building Code covering heavy timber construction calls for minimum nominal timber sections in the order of 8 × 8-in. columns, 6 × 8-in. floor girders, 6 × 6-in. roof beams, 4 × 6-in. roof truss and arch members, and 2-in. roof deck plank with variations permitted under certain conditions. A reduction in some member sizes is permitted when the structure is protected by automatic sprinklers.

Contributed by the Wood Industries Division and presented at the Annual Meeting, New York, N. Y., Nov. 25–30, 1956, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from ASME Paper No. 56—A-137.

Fig. 1 Segmental timber bowstring trusses and timber crane beams in assembly bay, sloped timber trusses on side wings, supported by timber columns

Criteria for Fire Safety

In referring to the fire resistance and safety to life and property afforded by engineered timber construction there is no intent to suggest that wood is not a combustible material. "Combustible is a relative term; many materials which will burn under one set of conditions will not burn under others; e.g., structural steel is noncombustible, but fine steel wool is combustible" (1).[1]

Such words as combustible, noncombustible, or fireproof are misleading when referring to fire safety of any structure. Freitag stated: "Construction bears little relation to the possible loss of life unless the construction is supplemented by fire-preventive design and precautions, and by fire-protective appliances and devices" (2). He might also have added that this applies to loss of content and structure as well as human life.

[1] Numbers in parentheses refer to the Bibliography at the end of the paper.

Cothron states: "There simply is no such thing as a fireproof building, especially with respect to life, as witness the tragic Cleveland loss some years ago when x-ray films stored in the basement of a fireproof structure burned. A number of patients were asphyxiated when the fumes were blown through the building" (3).

Noncombustibility

In the minds of some, the term noncombustible has somehow come to be regarded as a synonym for fire safety. The General Motors Livonia Plant fire did much to dispel this myth and bring thinking back to fundamentals. The Factory Insurance Association stated: "Before 3:40 p.m. on August 12, nobody even suspected that a fire like this could happen. The FIA considered the Livonia plant a low-rated risk. It was a noncombustible building with noncombustible machinery using noncombustible materials, and the end product was noncombustible" (4).

Regardless of the degree of combustibility of the materials used in a structure, there are other more important factors which determine the fire safety of the structure. In an analysis of the 316 large-loss fires in the United States and Canada in 1955, the National Fire Protection Association concluded that: "Past studies of fires have shown that large losses usually can be prevented by structurally limiting the area through which a fire may spread. Construction weaknesses have always played a prominent role in the large-loss fire experience, and the 1955 experience was no exception. Of the 225 fires that occurred in buildings, structural fire protection weaknesses played a significant part in the extent of damage in 200 instances" (5).

The most common weaknesses were enumerated as: absence of a division wall, substandard division walls (did not extend through roof, low fire-resistance rating, and so forth), and unprotected doorways in division walls. In buildings of more than one story, where fire spread beyond the story of origin, it did so because of open elevator shafts, nonfirestopped walls, and openings around pipes.

Fig. 2 Firemen are aware of the fire safety of heavy timber construction and use it for housing their equipment

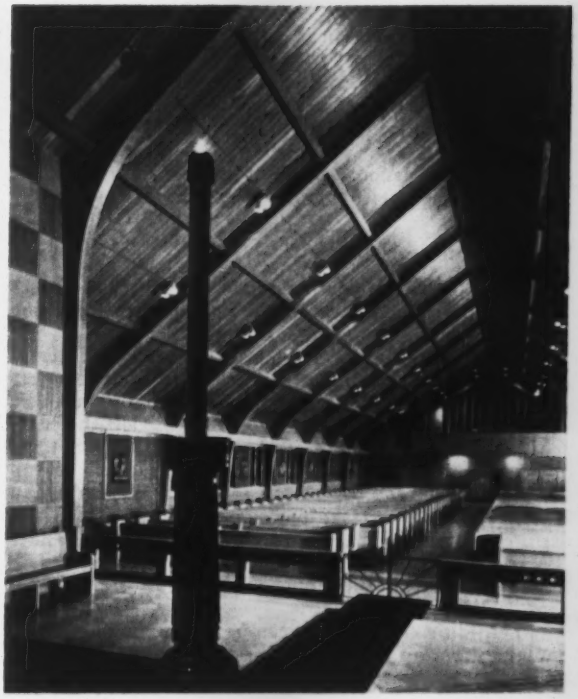

Fig. 3 Engineered heavy timber construction can be beautiful as well as utilitarian

Also, installation of a sprinkler system is a good precaution to protect the contents and reduce the loss from fire in buildings of any construction. Colonel C. G. Richmond, chief, Fire Protection Branch, War Department, Washington, D. C., reported on an analysis of 7464 fires during 1939–1942 in sprinklered industrial buildings having masonry walls as follows: "If but five of these fires are eliminated from the analyses because of special conditions and the remaining 7459 fires are analyzed, the average loss respectively in reinforced-concrete, standard-mill, and brick-joisted construction amounted to $348, $330, and $339. These figures give strong backing to the commonly made claim that automatic sprinkler protection properly installed and maintained over combustible occupancy reduces to a common level the probable extent of loss by fire in industrial buildings having masonry walls whether or not the interior construction is combustible or noncombustible" (6)

Greatest Loss in Contents

Currently, the value of warehouse contents lost in fires is now averaging three times the value of the building itself.

It is immediately apparent that there are then two important criteria for fire safety of life and property:

1 How well the structure performs in a fire, rather than whether the materials of which it is composed will burn. The contents (which are the important fuel factor) will burn in a building of any construction.

2 Proper engineering design, recognizing the importance of division walls, encloseds tairways and shafts, fire-

stopping, roof venting, adequate exists, and other common-sense precautions dictated by the use or content of the structure.

The fact that engineered timber structures do perform extremely well in a fire and have good fire resistance when modern building-code provisions are followed has not received wide enough recognition. Also, since the danger of collapse is small, inside or topside fire fighting is common practice with timber construction.

Fire Resistance of Timber

Wood is a very poor conductor of heat and consequently does not conduct high temperatures from one part to another part of the building.

Wood in any solid form is hard to ignite. In order to do so, there must be sufficient heat to drive out moisture and to vaporize the gums and some parts of the fiber; these vapors will then burn. There is then left the charcoal, which being largely carbon, cannot be vaporized at normal fire temperatures. Sufficient heat will set up oxidation of the charcoal, but this oxidation is extremely slow, especially in large pieces of wood in which the ratio of surface to mass is low. Consequently, timber construction has the advantage of permitting effective fire fighting without fear of sudden collapse of the building.

No building construction can be said to be immune to damage from fire. Steel loses its strength, distorts, and collapses at fire temperatures. Stone, brick, and concrete spall and crack. Wood chars, but it has the advantage of being more easily and economically repaired.

In many fires after the fuel or content causing the fire has been consumed, the wood structure will stop burning since the temperature drops below that necessary to oxidize charcoal. Thus the mere fact that wood will burn does not necessarily mean that it will spread fire. This was well demonstrated by a fire in a Lake Harbor, Florida, building framed with glued laminated arches 4 ft on center and sawed-wood purlins, and covered with aluminum roofing. The 0.024-in. aluminum sheet over the center bin disappeared completely in several places.

Resistance of Laminated Wood

Fig. 4 shows a cross section of a 9 × 27⅝-in. glued laminated beam which had been subjected to fire for one hour with temperatures ranging from 500 F to 1600 F and averaging 1270 F. It will be noted that the burning is quite uniform and the glue lines have little, if any, effect on the fire resistance of the timber.

As the U. S. Forest Products Laboratory (Wood Handbook) states: "The fire resistance of glued laminated structural members, such as arches, beams, and columns, is approximately equal to the fire resistance of solid members of similar sizes" (7).

The fact that timber construction under fire conditions is difficult to ignite and provides a charcoal layer of insulating character makes fire-retardant coatings and/or impregnation unnecessary in most cases. There are, however, some cases of extremely hazardous contents in ordinary timber structures which make such treatment a plus factor.

During World War II the Navy built a number of blimp hangars which are claimed to be the largest timber-framed buildings in the world. The framed-arch ribs and other framing lumber of these structures were pressure-impregnated with a fire retardant. One of the hangars at Tillamook, Oregon, since converted for use by a plywood manufacturer, sustained a fire started by a veneer drier which burned 40,000 sq ft of roofing but resulted in no damage to the structural timber framing.

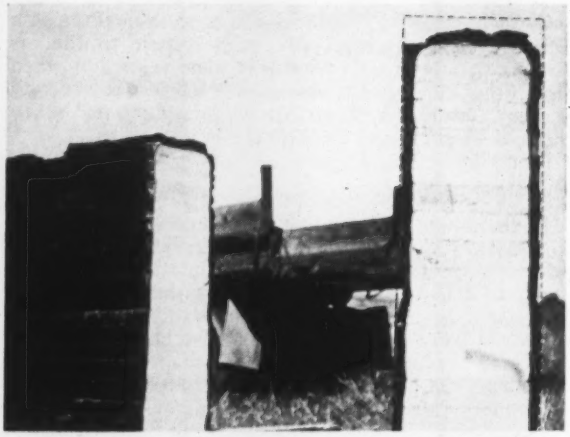

Fig. 4 Glued laminated wood members have very good fire resistance. A 9 × 27⅝-in. glued laminated beam was subjected to open fire test for 1 hr at an average temperature of 1270 F. Dotted lines indicate original section size. The sound uncharred section remaining was 7¼ × 26 in. Based on the ultimate strength of material, the beam is capable of continuing in service with a safety factor greater than 2 to 1.

More than 10 years ago a group of these hangars at the Richmond, Florida, Naval Air Station was subjected to fire after collapse due to extraordinary hurricane forces. Aircraft and automobiles parked in these hangars containing in excess of 40,000 gal of fuel were consumed. The fire-retardant treated lumber was consumed in the area exposed to the flame of these burning materials, but the treated wood did not support combustion in the collapsed framing debris beyond the edge of the gasoline pools or similar outside fuel.

In other words, lumber pressure-treated with fire-retardant chemicals does not support its own combustion, and it resists the spread of fire. Like untreated heavy timber framing, a severe exposure to a fire of long duration is required for its consumption.

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FIRST-LINE SUPERVISORS

. . . How Do They Spend Their Time?

On-the-job case studies, analysis, and a program for improvement

By Jerome S. Underhill

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THE first-line supervisor, more commonly known as the foreman, is recognized today as one of the most important and vulnerable links in the industrial organization chain. Guided by schedule and specifications, he is responsible for the quantity, quality, and cost of production. His supervisory ability is reflected in the morale and productivity of his operators (1).[1]

Countless numbers of books have been written for, and expensive training programs given to, the foremen to aid them in their supervisory development. Invariably, they are geared to describing management's idea of the "ideal supervisor."

Prof. James Surface of the Harvard Business School questions the soundness, from a psychological standpoint, of training supervisors by comparison to an ideal concept: "I submit that an element of the foreman's resistance to training is that he resents being measured against perfection . . . The foreman knows he is fallible. He would agree that he should continually seek to improve, but he would go along with new training programs more readily if he did not feel that management expected them to make him perfect" (2).

Despite its attempts to describe the function of a supervisor and to increase his effectiveness as a manager, management has made little effort to determine how a foreman actually spends his working hours. A supervisory study would show the individual supervisor, without comparison to an ideal concept, the areas where he is weak and would show management where it could best provide aid for its supervisors. It would provide the tools and aid for the supervisor to allocate his time more effectively to improve materially both his present performance and his personal development.

On-the-Job Analysis

By the application of a work-sampling technique (a variation of the old ratio-delay theory), management can find, easily and accurately, just how its supervisors spend their time.

In 1954, the Aluminum Company of America made just such a study of the foremen in its New Kensington, Pa., plant (3). The study was made for the expressed purpose of freeing the foremen from their nonsupervisory duties and "restoring them to their earlier positions as leaders and managers of men." The study showed that, contrary to expectations, the foremen were spending only about 31 per cent of their time in direct supervision.

In the spring of 1955, Merck & Co., Inc., made a similar study of the 13 supervisors in one production department at its Rahway, N. J., plant. The department was chosen because the area lent itself readily to a work-sampling study and because a problem existed with the supervisors being unable, because of lack of time, to perform all the functions the department head expected of them.

There were four distinct sections within the operating area. Three of the sections were on a two-shift operation, and the fourth was on a single day shift. The number of supervisors per section varied from one to three per shift. Each supervisor had 20 to 25 workers under him. In one remote service area, however, a supervisor had only four subordinates.

The workers consisted mostly of women operating semiautomatic-machine lines. The machines were serviced by men who made minor adjustments on the machines and transferred materials to and from them.

Each supervisory section had an office provided where the supervisors kept production records and discussed operating problems among themselves. Three sections had production clerks to maintain records.

The foremen in the four areas reported to an assistant department head. Two assistant department heads (one per shift—two shifts) reported to the department head.

Before the study began, the foremen were called together in groups by the department head, who explained in detail the purposes of the study and the method to be used to collect data. The engineer in charge of the study emphasized that the study would not, and could not, indicate the right way to supervise, but would rather suggest areas where nonsupervisory work could be reduced or eliminated. Without the wholehearted co-operation of the foremen, it was stated, the study would have little or no value.

When the study was begun, an observer followed a random path through each operating area making instantaneous observations of the foremen he met. Supervisory activity, area, and the specific supervisor seen were noted in each observation.

Breakdown of Activities

Each activity was placed in one of nineteen classifications. Supervisory walking 02, random equipment

[1] Numbers in parentheses refer to the Bibliography at the end of the paper.

Contributed by the Management Division and presented at the Annual Meeting, New York, N. Y., Nov. 25–30, 1956, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Paper No. 56—A-84.

checking 03, supervisory product checking 08, and clerk, operator, and serviceman instruction 10 to 12 were considered supervisory activities. The other duties were indirect supervisory (aid), or nonsupervisory.

When more than one activity was seen in an observation, the one requiring highest supervisory skill was noted. For example, an observation of a supervisor walking with and talking to an operator would be classed in element 12, operator instruction.

The observations were noted on mark-sensing IBM cards and the data tabulated by machine. (This reduced tabulating time from approximately three clerk-weeks to five man hours.)

The study revealed that the supervisors could devote only 25 to 30 per cent of their time to direct supervision (in agreement with the Alcoa study). They spent almost 20 per cent of their time as messengers, 10 to 15 per cent in clerical work, and 10 per cent with fellow supervisors.

Most of the daily activities of the first-line supervisor are related to personnel or production problems. He spends the majority of this time, however, noting what has happened (to keep his superiors informed) or preparing for what will happen (to keep his workers busy). The amount of time he can spend on the floor checking what is happening or in maintaining friendly relations with his men by personal contact is limited to the time remaining after he has filled in his reports and prepared for future production changes.

On a typical day he is on the floor a quarter of an hour before his men, preparing for the day's production. He assigns the crews as they report, giving only cursory operator instruction, while hurrying through the work area.

He spends the next couple of hours at his desk filling in the previous day's production records. At frequent intervals he rushes to the operating floor to solve operating problems, inspect materials going to or coming from the operating lines, or instruct the operators.

The day is divided almost equally between the office and operating floor. The foreman seldom is able to get ahead of his work and is always working under the pressure of production commitments. His contacts with the operators are few and are usually necessitated by an employee coming to him with a production problem requiring an immediate decision.

This is in complete contrast with most concepts of the supervisor's workday (1).

Program for Improvement

The data were reviewed with the operating personnel, and a number of procedural changes were agreed on to increase the foreman's time available for direct supervision from 30 per cent to 40 to 50 per cent. Among the more significant changes were these:

Clerical. The supervisors were required to prepare a number of production records. By transferring the work to clerks, the amount of nonsupervisory work was reduced, in some areas by three-quarters of an hour per shift for each supervisor.

Communication. One of the largest areas for improvement was, and remains, communication within and without the area. Each supervisor spent approximately one hour per shift on the telephone or in messenger walking caused by the telephone.

Elements of Supervisory Activity

01 *Messenger Walking.* Purposeful walking, having no significance except to travel.

02 *Supervisory Walking.* Walking slowly, simultaneously checking the process.

03 *Random Equipment Checking.* Checking operations and production records in the operating area as a routine matter of course.

04 *Equipment-Breakdown Checking.* Time explaining a breakdown problem to mechanics or helping the operator during breakdown.

05 *Clerical Work With Supply Orders.* Filling in requisitions for supplies, chemical requisitions, or stock transfer orders.

06 *Clerical Work With Time Sheets.* Checking and initialing incentive record sheets and weekly time sheets.

07 *Clerical Duties With Production Records.* Tabulating data on production histories, daily report of activities, down-time sheets, etc.

08 *Product Checking.* Random sampling of product or components during production—supervisory control activities.

09 *Routine Inventory and Inspection.* Routine product inspection or daily inventory of materials in area—nonsupervisory inspector-type operations.

10 *Instruction of Clerical Help.* All discussion with production clerks.

11 *Instruction of Servicemen.* All discussion with set-up or floor men.

12 *Instruction of Operators.* All discussion with operators.

13 *Personal Time.* Idle time or activity having no connection with process or personnel affairs. *Personal time spent outside the operating area (e.g., in cafeteria, locker room, etc.,) is not included in this category.*

14 *Process Conferences With Superiors.* Any discussion with the department head or the shift supervisors.

15 *Process Conferences With Other Supervisors.* Any discussion with other supervisors.

16 *Telephone Conversations.* Time spent dialing or talking on telephone (except time walking to or from telephone, which is included in element 01).

17 *Process Conferences With Personnel Outside Area.* Discussions with authorized personnel other than those in operating group.

18 *Process Paperwork.* Supervisory paperwork—time filling in personnel evaluation forms, reading supervisory bulletins, or checking process documentation.

19 *Routine Operator Duties.* Any routine work that should, or could, be performed by an operator, including any operator work performed during operator absence.

A temporary procedural change has been instituted in one area to contact the supervisors only through a loudspeaker system. This could reduce the communication time by as much as one third.

Inspection-type checking. Throughout the study an attempt was made to differentiate between inspection-type and supervisory checking. Any random checking of material for in-process control was felt to be a supervisory duty. One hundred per cent inspections, however, were nonsupervisory duties that should be transferred to the inspection group.

The supervisors in one area were required to make a number of one hundred per cent product inspections. This practice was discontinued.

One of the most intriguing aspects of the study was the possibility that a supervisor's pattern of activity could provide an objective measure of his supervisory performance.

The assistant department heads were asked to rate the foreman by a triangular preference test. They checked the best supervisor out of three in all possible combinations of three supervisors. There was no correlation between the objective rating of the foremen by their activity pattern and the subjective rating by the preference test.

There are probably two reasons for this. First, the 13 supervisors were assigned to seven different work areas. The job variation from area to area had a more profound influence on the activity pattern than any personal variation between supervisors. For example, two supervisors rated very high by their superiors had a large sprawling area to cover. They were forced to spend more time in walking and, therefore, less time in direct supervision. Second, there was no attempt to measure how effectively the supervisors spent their time. Since the evaluation was only quantitative, it could not give a total measure of supervisory performance.

The study did indicate, to a limited degree, the relative strengths and weaknesses of the various supervisors. For example, one supervisor spent twice as much time in clerical activities as the others; another spent twice as much time with fellow supervisors as the average. The requirements of management, however, had a more significant influence on the supervisory activity pattern than the personal variation among supervisors.

Conclusions

1 It is generally the fault of management that supervisors do excessive nonsupervisory work.

The amount of time a supervisor is able to spend in direct supervision is largely determined by factors outside his control. He may have a large physical area to cover, he may be saddled with clerical work he must perform, or he may be required to do nonsupervisory product inspection. In any case, he will be able to spend only as much time in direct supervision as remains after he has performed required nonsupervisory work.

2 A work-sampling study can, and should, indicate where nonsupervisory work can be reduced.

It is reasonable to expect the amount of supervisory time available for direct supervision to be increased from 30 to 50 per cent as the result of a study. It cannot be emphasized too much, however, that the success of the study is completely dependent upon the co-operation received by the supervisors and their superiors.

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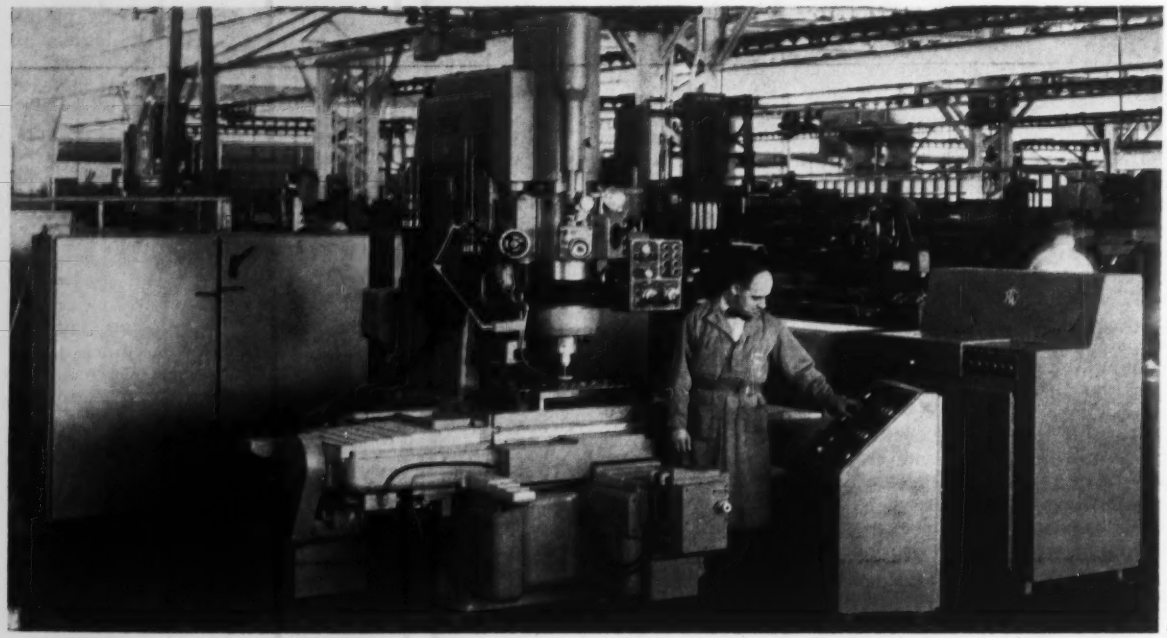
Briefing the Record

Abstracts and Comments Based on Current Periodicals and Events

J. J. Jaklitsch, Jr., *Editor*



The entire assembly for a Pratt & Whitney numerically controlled machine-tool operation. All blueprint data needed for locating, indexing, boring, and grinding are stored on punched tape and translated directly into mechanical action by the machine. The units are: control cabinet, *left,* hole grinder, *center;* control panel; cabinet, *right,* containing tape into which digital information has been punched to automatically and accurately position the workpiece.

Numerically Controlled Machine Tools

THE development and perfection of a wholly new system of numerical control as applied to jig borers, vertical-hole grinders, and rotary tables have been accomplished by Pratt & Whitney Company, Inc., West Hartford, Conn., a subsidiary of the Penn-Texas Corporation. The first units have been delivered to the Aircraft Engine Division of Ford Motor Company in Chicago, Ill.

Pratt & Whitney's system of numerical control is believed to be the nearest approach yet devised toward complete automation of machine tools of this type. It makes possible automatic accurate positioning within 0.0001 in. Vital machine tools that formerly could be used only as toolroom equipment can now be made available for efficient volume-production purposes.

With the new system all blueprint data needed for locating, indexing, boring, and grinding are stored on punched tape and translated directly into mechanical action by the machine. The system actually feeds blueprint information directly to the machine.

Numerical control boasts many important features which provide important production advantages. Chief among these are: Elimination of human error in reading or setting dials or verniers; ability to set rapidly all slides and verniers simultaneously; reduction of scrap losses and consequent cost reduction; increased operating speeds and efficiency; minimum setup time; constant precision since the machine is automatically controlled; fewer jigs and fixtures; faster cycle times resulting from automatic operation. Since numerical control offers automatic programming, the high precision of jig borers, precision hole grinders, and rotary tables is made available for production work. Punched tapes are easily and economically prepared, and take the place of costly and complex fixturing. Thus automatic programming and operation become practical for short production runs and for machining of one or two pieces with multiple holes with a minimum of operator fatigue.

Operator-training periods can be substantially reduced since the high skill needed for precision work is built into the numerical-control system.

In addition to the advantages of any automatic-control system over conventional operator control, the system has demonstrated important advantages over other types. All of the company's Series E jig borers, vertical precision hole grinders, and rotary tables are supplied with electrolimit measuring systems which are capable of settings accurate to 0.0001 in. or 5 sec of arc, resulting in the most accurate machine control yet devised when used with numerical control.

Based on the common decimal system (decimal of an inch and decimal of a degree of arc), the dimensions shown on a blueprint are punched on tape as easily as numbers are tabulated on an adding machine. This decimal system eliminates the necessity for making complex mathematical "translations" which are required by automatic-control systems based on binary numbers.

A pneumatic sensing system is used for the tape reader. Air is forced through holes in the tape to an enlarged chamber with a neoprene diaphragm which provides enough force to operate a reliable industrial-control limit switch.

The tape is moved into position and stopped automatically. It is at the stopping point that all data on the tape necessary for a single operation are read at one time and presented automatically to the machine. When the machine operation has been completed and checked, the tape can be advanced one block so that new information may then be presented.

The first large unit—a vertical precision hole grinder—has been shipped to Ford Motor Company's Aircraft Engine Division in Chicago, Ill., and two other big machines are scheduled for early delivery to the Pratt & Whitney Aircraft Division of United Aircraft Corporation, in East Hartford, Conn.

Compact Gas Turbine

Solar Aircraft Company, San Diego, Calif., has been awarded a Navy Bureau of Ships contract to perfect a compact, high-efficiency 1000-hp gas-turbine engine, known as the Saturn, which has widespread applications for small-boat propulsion. It will be both lighter and smaller than present 500-hp gas turbines, with only a fraction of the size and weight of marine-diesel engines, and fuel consumption lower than that for any gas turbine in its power range. The only engine of its type specifically designed for marine propulsion, the Saturn will also be adaptable to driving a 500-kw generator.

According to Solar engineers, the 1000-hp Saturn will be only 2 × 2 ft and weigh 500 lb. This weight compares with 550 lb for Solar's 500-hp Jupiter gas turbine, and with weights of from 10,000 to 20,000 lb for diesel marine engines of similar capacity.

Known as the Solar T-1000S, the Saturn will be a variable-speed engine with an eight-stage axial-flow compressor and a three-stage axial-flow turbine. Two stages of the turbine will power the compressor, and the remaining single stage will drive the shaft. The Saturn will use an annular combustor, permitting a completely symmetrical design and minimizing all ducts and duct losses. Both start and acceleration are completely automatic. The Saturn will operate 2000 hr between overhaul inspections. It will be designed to operate on diesel fuel and will incorporate featurs toe provide necessary ruggedness for Navy use.

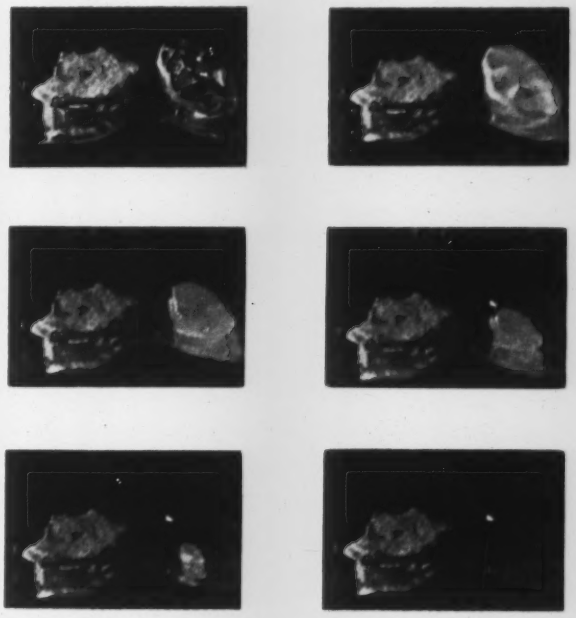
The Saturn will be used by the Navy to power new types of landing patrol craft. The high speeds demanded of these boats require a lightweight engine. Depending on the size and mission of the boat, one or more gas-turbine engines will be employed. In some cases the gas turbines will be used in tandem arrangements.

Gas turbines offer a number of advantages in marine propulsion as compared with conventional power plants, according to Solar engineers. In addition to their compactness and light weight, they are simple and easy to maintain; they have very little vibration; no cooling water is required; they require no warm-up time; start easily at low temperatures; and are highly reliable.

Diamond-Hard Abrasive

"Borazon," cubic boron nitride, the equivalent in hardness of the diamond, is being produced in sand-grain size by the General Electric Research Laboratory, Schenectady, N. Y. Whereas diamond burns in air at 1600 F, Borazon can withstand more than 2500 F, suiting it for a greater variety of industrial applications. The greater resistance to oxidation will also make possible superior methods of mounting stones in industrial tools and allow bits and wheels to operate at higher speeds.

Many substances crystallize in more than one form, depending mainly upon the crystallizing pressure and temperature. Ordinary boron nitride is a white solid similar in slipperiness, density, and crystal structure to black graphite. Boron and nitrogen "flank" carbon in the periodic table of elements. Pressures above



Diamond burns and borazon remains unaffected at +1600 F in this sequence of photographs taken at 30-sec intervals. The combination of diamond hardness and resistance to oxidation at high temperatures makes borazon suitable for many industrial abrasive uses.

1,000,000 psi and temperatures exceeding 3000 F are used to produce crystals of boron nitride with a structure that is not hexagonal like graphite but cubic like diamond. X-ray diffraction tests of borazon reveal that the alternate atoms of boron and nitrogen are packed together almost as closely as the carbon atoms in diamond, and density is also about the same with a 3.45 sp gr for borazon and 3.50 to 3.56 sp gr for the diamond.

Gas-Turbine Locomotives

THE Union Pacific Railroad has ordered a second group of fifteen 8500-hp gas-turbine electric locomotives from the General Electric Company Schenectady, N. Y.

The first group of 15 was ordered in November, 1955, with delivery scheduled to start in July of this year. Total cost of the second 15 locomotives will be about $15,000,000 with delivery expected to begin early in 1958.

This new type locomotive will be the most powerful in the world, according to U. P.

A fleet of 25 smaller gas-turbine electric units rated at 4500 hp has been in regular freight service on Union Pacific for several years. Latest announced figures show that this relatively small number of units is hauling 10 per cent of U. P.'s total freight tonnage.

The new locomotives will be built in two sections permanently coupled together with an enginemen's cab at one end. Coupled behind the units will be a fuel tender of 24,000-gal capacity, insulated to retain the heat of fuel which is heated as it is loaded. Use of the tenders gives the locomotives greater operating range without refueling and insures a constant weight on the driving wheels. Use of internal fuel tanks would result in a reduction of the weight of the unit as fuel is burned and a consequent loss of traction. The tenders will be built by Union Pacific.

Geared for freight service, the locomotives will have a top speed of 65 mph. A total weight of 408 tons will be distributed on 12 axles. Over-all length with a fuel tender will be slightly more than 165 ft and height will be 16 ft.

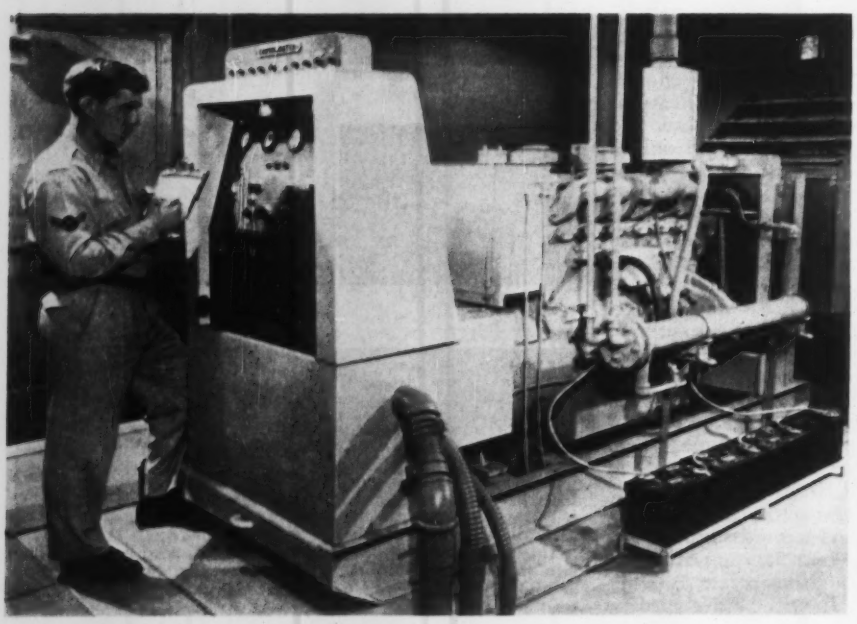
Automatic Diesel Power

A COMPLETELY automatic diesel power plant which thinks for itself, turns itself on and off, sends signals about operating conditions to technicians in a control center miles away, and operates without manpower in attendance, has been developed for use in radar systems in the United States.

The compactly packaged primary-power units are designed by Consolidated Diesel Electric Corporation for gap-filler radar stations. These installations provide a fence or alarm system between main and auxiliary stations where uneven terrain or other reasons make maintenance difficult. Because radar installations are designed to operate from commercial power supplies and lines where available, the power plants will stand in reserve or be used as a source of auxiliary power in regular operation. Normally, the power plant will include two diesel generator sets and a "brain" or power-supply control. Each is completely automatic, designed to operate without personnel in attendance, provide power to the full load in less than 12 seconds, and relay operational information back to the central control point.

If, for example, one diesel-generator set of the power plant ceases to operate at full capacity or fails because of insufficient lubricating oil—or any other malfunction—the second unit automatically turns itself on and assumes the load.

At the same time, the inoperative unit returns itself to the standby position, turns itself off and relays back to the main control plant that it has failed and the reason for the failure.



Completely automatic power package for use as a primary power source for four-fifths of all unmanned radar installations in the nationwide Semi-Automatic Ground Environment system. The Model 4000 generator set is designed around an electric "brain" or control cabinet which sends signals to a control center miles away.

The "Memory System" which records control or mechanical deficiencies or failures in the units, indicates to technicians at the control point what repairs are necessary and what parts need adjustment or replacement.

500-Ton Ladle Cranes

THREE 500-ton ladle cranes are being built for a large eastern steel mill by the Morgan Engineering Company, Alliance, Ohio. Where the currently used 250-ton-capacity cranes require three trips from furnace to mold to complete a given pour, the new "500" will be able to accomplish the job in one trip.

The 920-ton weight of this type of crane requires operation of a large trolley with weight distributed by four-wheel trucks in place of the customary two-wheelers. An auxiliary or small trolley is used to tip the empty ladle and for open-hearth cleaning purposes. The crane is driven by 11 electric motors totaling 1658 hp, and reeved with $1^2/_3$ miles of steel wire rope or cable. The ladle has a 17-ft diam, 13-ft-10-in. bottom diam, and is 17 ft $3^1/_2$ in. high.

New "Brain"

A LARGE-SCALE electronic computer specifically designed to help business management solve its problems scientifically has been announced by International Business Machines Corporation. The IBM 709 latest of the company's 700-series of electronic data-processing machines, is the first equipment of its capacity that can work with equal facility on both commercial and scientific or engineering calculations.

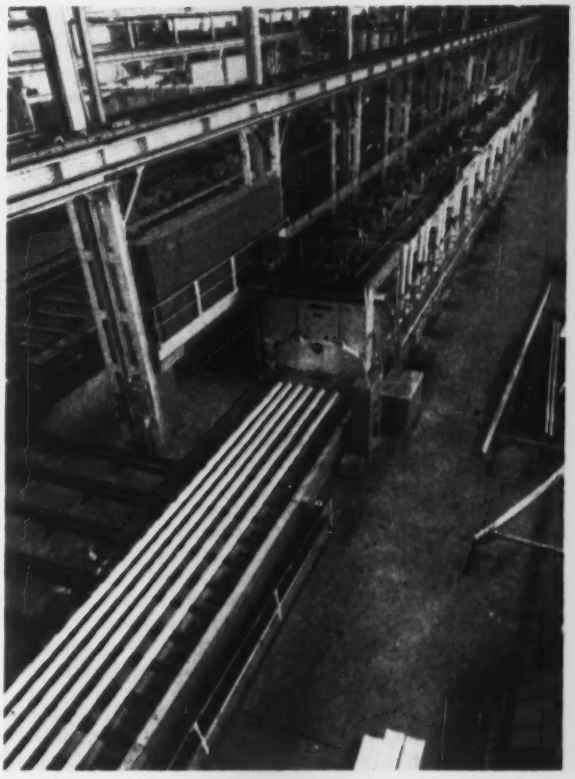
The 709 will be able to pinpoint the best possible location for a new plant, forecast sales, and optimum distribution, or handle a variety of routine and specialized accounting operations.

Instructions unlike any of those utilized by present-day stored-program computers provide greater programming flexibility, and permit rapid calculations on data prepared in number systems other than the 709's basic system of binary arithmetic. All problem data can thus be kept in whatever form is most economical and desirable for the work at hand, rather than in a number system compatible to the computer.

IBM's 729 Magnetic Tape Unit which automatically checks information for accuracy as it is being written on the tape, is another new feature. The unit signals when an error is detected, the tape-writing operation may then be stopped, and the information rewritten.

Arithmetical operations are performed at speeds up to 42,000 additions or subtractions and 5000 multiplications a second.

An important contributing factor to this extraordinary calculating speed is the 709's rapid-access, high-capacity magnetic-core storage or "memory." Up to 32,768 "words" of problem or instruction data can be held in core storage, a word being equal to a ten decimal digit number. This means that the equivalent of over 327,000 decimal digits can be stored in the 709. Any word in core storage can be located and made ready for use in only 12 millionths of a second. The magnetic core-storage unit's tremendous capacity fulfills the need for completely internal high-speed handling of voluminous problem data, reference tables, and lengthy programs.



The Westinghouse roller-hearth furnace at the Halethorpe, Md., plant of Kaiser Aluminum Company handles 100-ft-long aluminum-alloy extrusions. Replacement of vertical operation reduces heat-treating time about half, improves the quality of the end product and eliminates the separate handling of each piece by hoists and cranes for quenching and lifting.

Roller-Hearth Furnace

A NUMBER of separate operations in the heat-treating of large aluminum-alloy extrusions have been eliminated at the Halethorpe, Md., plant of Kaiser Aluminum Company. The application of a roller-hearth furnace built by the Westinghouse Electric Corporation, which replaces vertical operation improves the quality of the end product and reduces heat-treating time about half. The furnace is capable of handling extrusions up to 100 ft long.

Prior to the installation of this new furnace, extrusion heat-treating operations were handled in vertical furnaces, over vertical quenching pits. Each extrusion had to be separately handled in lowering the piece into the quench and hoisting it into the furnace. With the new roller-hearth furnace, extrusions are brought to a 103-ft charging table by conveyer; charge doors raise automatically and extrusions go into the 112-ft furnace at the rate of 50 fpm. The furnace itself has a maximum operating temperature of 1000 F, and a total rating of 7.5 million Btu per hr. During the heating cycle the furnace rolls oscillate. After the necessary heating and soaking time has elapsed, discharge doors open, and the extrusions pass through a 45-ft quench spray and onto the 104-ft runout table.

Metallurgical Briefs

▶ Boron 1200-F 75,000-Psi Alloy

An iron-nickel-chromium-molybdenum-titanium-boron alloy designated W545, and basically a modified version of discaloy, developed about ten years ago by Westinghouse Research Laboratories, is in the pilot-plant stage at the company's new metals-manufacturing plant in Blairsville, Pa. Tested at 1200 F and 75,000 psi, samples withstood these conditions for as much as 300 hr without breaking.

The metal is particularly suitable as a turbine-disk material for jet aircraft where the energy for propulsion is obtained by increasing the temperature of the air passing through the engine. As a general rule, the greater the increase in air temperature, the more thrust a given engine will produce and the faster the airplane will fly. To continue development up the supersonic scale, engines must be able to run at higher and higher temperatures without significant loss in the mechanical strength of the components.

Jet turbine disks are metal wheels bolted to the aft end of the rotating shaft of the engine with 50 or more turbine blades anchored to the outer rim. White-hot gases from the burning fuel push against the blades to spin the disk and shaft at 20,000 rpm with stresses as great as 50,000 psi. Present materials have been pushed to the limit, whereas W545 may permit 100 F increases in operating temperature and add 100 mph to the jet's top speed.

The usual loss of ductility and resulting brittleness which accompany hardening have been avoided by the addition of boron to the alloy. Low ductility starts to grow during the hardening process when imperfections and dislocations of the atoms occur along the individual grain boundaries of the alloy. Boron fills up these spider-web lines of brittleness making the precipitation reaction more generalized within the grains rather than concentrated at the boundaries. The size of the substitute atom had to be such that it would not merely move into the alloy lattice as a substitute for one of the iron, cobalt, nickel, or chromium atoms which are about identical in size, but also had to be larger than the carbon, nitrogen, or oxygen atoms which can actually slip inside the crystal lattice of the alloy. Boron is approximately $^3/_4$ of the size of the iron atom and just right—too small to be a substitutional type atom and too large to be the interstitial type.

▶ Iron-Base 1500-F 15,000-Psi Alloy

A new high-strength alloy for key jet-engine components operating in the 1200 to 1400 F temperature range with a life of 1000 hr or more at 15,000 psi and 1500 F has been developed by General Electric's Flight Propulsion Laboratory Department in the Aircraft Gas Turbine Division near Cincinnati, Ohio. Designated J1300, the new material is the latest in a line of G-E-developed jet-engine alloys which includes J1500 and J1570, two high-temperature materials in current use. It has a low content of strategic metals with no cobalts, no columbium, and little nickel.

A high-strength iron-base alloy with a strength-to-weight ratio 25 to 40 per cent better than comparable materials in this temperature range today, J1300's operating temperature is 100 F higher than materials now in use. While making possible a reduction of several hundred pounds in over-all engine weight, J1300 pushes jet performance beyond that obtainable with currently used materials.

An excellent high-strength bar and forging material for the medium-temperature range, the alloy also has great potentialities as high-strength sheet in the 1200 to 1400 F range. Because of its demonstrated weldability and formability, plans are now under way to specify J1300 for critical structural sheet components throughout the entire engine.

The J1300 alloy has reached the prototype production stage in its development, and along with J1500 and J1570 is now being produced by G-E's Metallurgical Products Department at Detroit.

▶ Columbium (Niobium) Alloys

"A little-known metal, columbium, also known as niobium, may provide the long-sought answer in the production of gas-turbine engines, such as those used in jet aircraft, that will enable such aircraft to operate at speeds far in excess of today's models," according to Dr. Morris A. Steinberg, head of the Metallurgy Department of Horizons Inc., Cleveland, Ohio.

According to Dr. Steinberg, "if the temperature of application can be increased, the size of the engine can be decreased, with no loss in power output. Today, however, materials used in the manufacture of these engines can only withstand temperatures up to 1800 F, and thus there is a serious limiting factor on the top power output possible."

Until now, columbium has been used almost exclusively as a minor alloying element in stainless steel to reduce the brittle characteristics encountered in fabrication operations such as welding.

While sometimes thought of as a rare metal, in truth the actual reserves of columbium in North America are in excess of the combined known total of reserves of molybdenum and nickel.

Apart from the possibility of 1800-F alloys for gas-turbine engines, there are other important applications indicated for columbium, particularly in the nuclear energy field.

Columbium has a low neutron cross section, 1.5 barns, and does not suffer extensive radiation damage. Uranium alloys containing appreciable amounts of columbium are being developed to give far greater life as fuels than presently used uranium-base alloys.

Important applications in reactors as a cladding material and in piping for those reactors where liquid metals are being used as coolants are suggested, since the corrosion resistance of columbium to liquid sodium, sodium-potassium alloys, and other liquid metals is exceptionally high at elevated temperatures.

In the nuclear field, small-scale production of columbium already is under way. Conceivably columbium may challenge zirconium as a nuclear structural material in reactor use within the next five years.

Despite the promising future for the metal, Dr. Steinberg notes several important problems that must be solved before it can be so used.

In many of the large North American reserves, columbium is tied up in complex ores requiring special ore-dressing and concentration methods for economic recovery. A large number of processes which promise to separate columbium from its companion, metal tantalum, have already been announced.

Another problem is the development of economic metal-preparation methods so that columbium can be made available in a high degree of purity and at low cost.

The present price per pound for the highest purity grade is $160; for an intermediate grade of purity, the price is currently quoted at $75. Dr. Steinberg predicts, however, that the price should drop to $15 to $20 per lb in the next few years.

▶ Cast Alloy With 140,000-Psi Tensile Strength

High-strength cast alloy with much better mechanical properties than the usual "18-8" stainless steels was described at a meeting of the Technical Research Committee of the Alloy Casting Institute, by M. G. Fontana, chairman, Department of Metallurgical Engineering, Ohio State University.

The alloy developed in the University's Corrosion Research Laboratories is reported to have better machinability than 18-8 stainless; good welding and grinding characteristics; and good foundry characteristics, including fluidity and feeding. Designated as type CD-4MCu, the alloy has the following composition range: 25 to 27 per cent chromium, 4.75 to 6.00 per cent nickel, 0.04 per cent carbon, 1.75 to 2.25 per cent molybdenum, 2.75 to 3.25 per cent copper, and 1 per cent each silicon and manganese.

Corrosion rates are of the same order of magnitude as the 18-8 stainless.

Results of tests on two production heats made by Alloy Castings Institute member companies prove the excellent mechanical properties of the new alloy. Specifically, the elongation and reduction of area values reveal its high ductility, even at hardness of approximately 300 Brinell, tensile strength of 140,000 psi, and yield strength of 100,000 psi. Properties for "comparable" 18-8 alloys would be approximately 77,000 psi tensile, 37,000 psi yield, and 150 Brinell hardness.

▶ Demystifying Inclusions

Perfection in alloys is marred by tiny foreign bodies, called inclusions, that show up along grain boundaries or within a crystal itself. The source of these impurities or inclusions has always been difficult to run down partly because of size since some of the smallest run between three and five mils in diam.

Using a commercially available power-operated microdrill only one mil in diam, metallurgists in the Westinghouse Materials Engineering Department are now able to remove samples of the inclusion for analysis on their emission spectrograph. This analysis method burns the sample under high voltage, which in turn releases radiation characteristic of the elements present. This is recorded on film where it can be later picked off and analyzed for the percentages of certain elements.

If the inclusion is large enough and not too hard, the tiny microdrill can be driven directly into the material and the cuttings used for analysis; or if the inclusion is extremely small or intensely hard, then it becomes a matter of drilling a series of holes around the inclusion and actually lifting it out of its surroundings in the base metal.

For example, in a welding operation, spectrographic results of microdrill filings showed the inclusion consisted of major iron and minor manganese concentrations. With definite elements to track down, engineers concluded that particles came from grinding wheels used in finishing the surfaces for welding and took measures to eliminate this contamination. Again the elimination of these inclusions prevented the development of stresses and cracks in the weld.

▶ Internal Microhardness Testing

A method of correctly determining the microhardness of the interior surfaces of chrome-plated metal castings has recently been developed. These castings, used by all types of industry, had to have wear-resisting qualities to protect the interiors against the ravages of time, corrosion, metal fatigue, and eventual failure in service. In certain heavy-duty and high-pressure applications, they are called upon to carry or transport viscous chemicals, toxic liquids, wastes, etc.

Credit for adapting a standard Type MO Tukon Tester, a product of the Wilson Mechanical Instrument Division, American Chain & Cable Company, Inc., New York, N. Y., goes to ALCO Products, Inc., Schenectady, N.Y.

"Prior to perfecting this application," according to G. R. Griffith, ALCO's manager of general engineering and testing, "we could not effectively determine the hardness of the chrome-plated interiors of our castings. Of course, we could readily determine the hardness of the outside surfaces, but this is not too important as there is no wear and tear involved. Furthermore, it is our belief that we are the first manufacturer who is determining microhardness in this manner."

An ALCO metallurgical engineer uses the Wilson Tukon microhardness tester to check the chrome-plated lining of an ALCO cylinder lining for the company's Model 251-B engine

The tester is mechanically operated and load is applied under dashpot control, the speed of which may be varied from less than 0.04 in. per min to as fast as testing permits without influencing the results. As a consequence, the rate of application and duration of applied load are under the constant supervision and direction of the operator. Loads from 1 to 1000 grams can be applied to any and all specimens under observation. Focusing the impression under the microscope is accomplished through the unit's elevating mechanism.

▶ Improved Magnetic Alloy

Substantial improvements in magnetic amplifiers, switching and memory devices, pulse transformers, and power transformers are now possible as a result of a new magnetic alloy which has been developed at Bell Telephone Laboratories, New York, N. Y. The material will permit reductions in the size of magnetic components without any sacrifice in performance, and will facilitate the design of new components having greatly improved performance characteristics.

H. L. B. Gould (*left*) holding a roll of Supermendur tape, and discussing its properties with D. H. Wenny. In the background is an experimental Laboratories' mill for cold-rolling Supermendur to thicknesses as small as 0.0003 in.

Called Supermendur, the alloy has a number of exceptional properties, including higher permeability and lower hysteresis losses at higher flux densities than any material heretofore available.

"Package" Water Plant

A PACKAGE water plant capable of satisfying emergency water requirements of 50,000 people is now undergoing troop tests by sanitary engineers at the U. S. Army Corps of Engineers' Research and Development Laboratories, Fort Belvoir, Va. The plant, which can purify water up to rates of 12,000 gal per hr, can be operated by one man, and is producing drinking water from the polluted Potomac River.

Designed for field erection, the plant consists of three main all-aluminum sections—an "Erdlator," and two gravity-type sand filters. The Erdlator, a cone-shaped up-flow 14-ft-diam coagulation basin removes mud, bacteria, and other suspended matter from the water and makes effective disinfection and filtration possible.

When the raw water enters the Erdlator, it is aerated and then thoroughly mixed with the coagulant, ferric chloride; the coagulant aid, pulverized limestone; and the disinfectant, calcium hypochlorite. Subsequent flow through the clarification zone permits agglomeration of the chemical precipitates and the colloidal particles in the water, and the hydraulic separation of the resultant slurry. The coagulation process is continuous and is accomplished in approximately 20 min. Excess slurry is continuously withdrawn, concentrated, and discharged to waste.

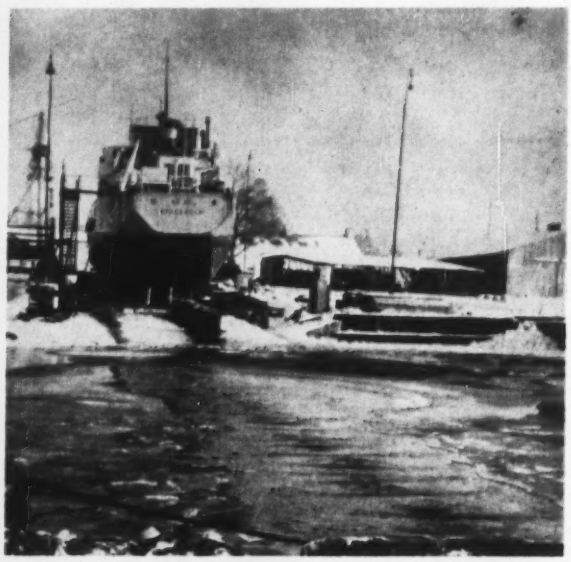
Effluent from the Erdlator is discharged to two open-type gravity sand filters operated in parallel. The filter effluent is collected in a bolted-aluminum water-storage tank for subsequent pumping into a pipe distribution system.

It is expected that the plant will be used at hospitals, prisoner-of-war camps, air bases, and at various other installations.

Housed in a 40 × 40-ft building, it is the largest in the family of water-purification units developed by the Laboratories' Sanitary Engineering Branch to meet field requirements. Rounding out the family are an airborne trailer-mounted unit rated at 600 gal per hr and truck and skid-mounted versions which can purify 1500 and 3000 gal per hr of water. All units operate on the same principle.

Ice-Free Navigation

THANKS to compressed air, it is possible that strategic inland waterways, arctic and antarctic seaports, mill ponds, hydroelectric dams, irrigation channels, and other large and small bodies of water can be kept open for navigation even through the coldest winter freeze-ups.



A Swedish shipyard near Stockholm shows a free-water pool kept open for launching purposes by compressed air supplied from the yard's permanent compressor installation. Pumped down through perforated galvanized pipeline running along the bottom of the channel, the air bubbles back to the surface. Constant aeration prevents ice formation.

The answer to ice-clogged northern ports and waterways has already been found in Sweden and currently is being tested in North America at the Slave Falls Dam, part of the hydroelectric system for Winnipeg, Canada according to Graham Corrigan, vice president and general manager of Atlas Copco Eastern, Inc., of Paterson, N. J.

An Atlas Copco air compressor is being used at the Slave Falls Dam to pump air through a $1\frac{1}{2}$-in. pipe running across the 1200-ft dam about 14 ft below the surface. Air bubbles released from the pipe at approximately 50-ft intervals, stream toward the surface, carrying along some of the warmer water from the bottom of the pool which melts the surface ice. Air pressure for the project is provided by an Atlas Copco Model AA 32 compressor operating on minimum-power input.

The antifreeze effectiveness of compressed air has been proved on a number of Swedish projects and a permanent system is being installed along the 2940-ft ferry route linking Adelso and Munso on Lake Mälaren in central Sweden.

Originally, the ferry operators spent about $1000 annually sawing ice out of the boats' paths. A permanent compressed-air system costing only about $1600 plus nominal annual compressor-operating charges solved the problem. Ice along the edges of the aerated open-water channel—about 32 ft wide—measures up to 20 in. in thickness during the height of the winter season. Despite temperatures lower than −20 F, ice never forms on the ferry channel itself.

The Atlas Copco antifreeze system also is being used on a 500-ft ferry channel at Ulvsundets in the Stockholm Archipelago and in a shipyard near Stockholm as well as at the Kastets sawmill pond near Gavle in Central Sweden.

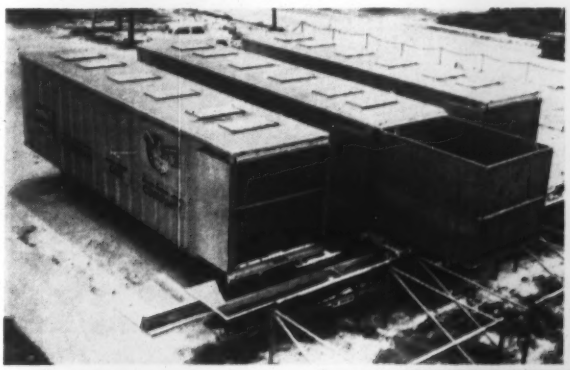
Piggybacks and "Trailer-Baks"

With a miniature conveyer installed in the bottom of a truck trailer, a new concept of transportation, "Trailer-Bak," is making its entry into the piggyback, fishyback, and birdback field.

Bulk trailer loads—one stop for load and one stop for delivery—with an automatic self-unloading trailer, is the latest innovation.

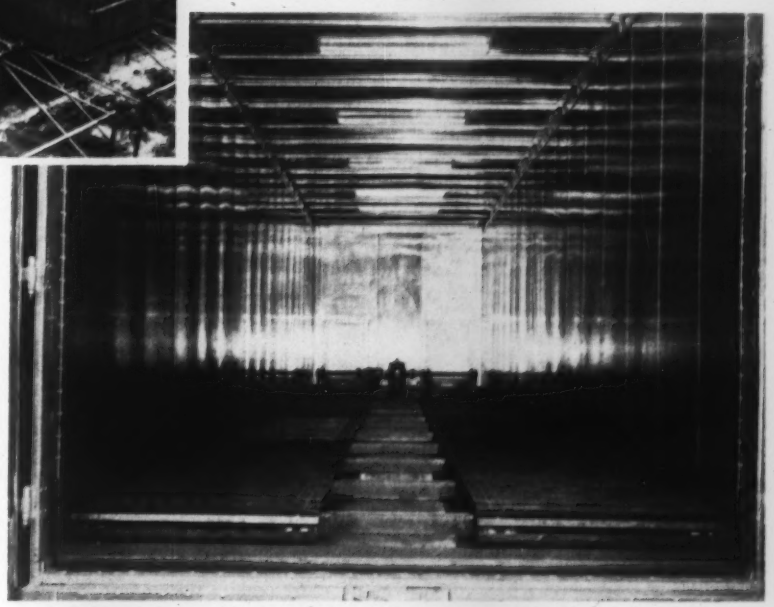
The new transportation technique consists of loading jumbled cans into a removable and reusable compartmented box or "liner" that in turn fits snugly inside the trailer. By means of a small, reversible Trailer-Bak conveyer, secured to the trailer bed, a loaded liner can be moved into the trailer for shipment and out again at destination for unloading. This liner can also be loaded through hatches in the trailer roof while in the trailer.

This system eliminates the conventional method of shipping cans positioned manually in orderly rows and obviates expensive dunnage in the form of liners, fillers, and bracing. Now, cans are merely "poured" or jumble-loaded into the compartmented liner which is retracted into the trailer for shipment. At destination the



▲ Three trailers have been equipped with special "live bottoms" or Link-Belt conveyers for use in the jumble method of shipping and handling cans. Hand-stacking is eliminated, the cans merely being poured through roof hatches into the compartmented "liner," shown partially extended from the center trailer. The conveyer-belt units which extend just $8\frac{1}{16}$ in. above the trailer floor are the key to the system. These can also be removed for conventional use of the trailer.

▼ When the trailer arrives at its destination, the conveyer belt smoothly rolls out the compartmented liner at the speed of only 12.8 fpm. Trap doors on the underside of each compartment open as the section clears the tailgate, pouring cans onto another belt conveyer which carries them to the receiving point. A single load can handle 125,000 cans of the 6-oz size, and great savings in time are promised for the handling of the more than 40 billion cans used each year in this country.



liner is smoothly rolled out and, as it clears the tailgate, a trap door on the underside of each compartment swings open, discharging cans into a belt conveyer which carries them to the production lines.

Each liner-box in the initial test runs held 125,000 concentrate cans, which weighed 10,280 lb. This comprised the static and/or live load carried on the Trailer-Bak conveyer.

With more than 40 billion cans used each year to bring a tremendous variety of products to the American consumer, this new method of bulk-container delivery holds definite possibility for increased payloads.

The Trailer-Bak conveyer, which makes the new technique possible, was developed by the Link-Belt Company, Chicago, Ill., and consists of two slat conveyers that travel at a modest speed of only 12.8 fpm to form a smooth, gently moving platform. Channel slats are mounted on precision-made finished-steel roller chains, with oversized rollers to insure a smooth and true conveyer action. The chain operates over cut-tooth sprocket wheels mounted on shafts rotating in ball-bearing blocks. Head shafting is directly connected through flexible couplings to a compact double-reduction worm-gear speed reducer powered by an electric motor which can be readily connected to power outlets at the shipping and receiving docks. The complete "live-bottom" device, exclusive of motor, stands just $8^1/_8$ in. above the trailer floor when installed. Attached by several hold-down bolts, the unit is completely portable and can be removed readily to make the trailer available for other conventional forms of transportation.

Fire-and-Overheat Detector

A NEW type of continuous fire-and-overheat detection system for airborne fire protection was demonstrated recently by Fenwal, Inc., of Ashland, Mass.

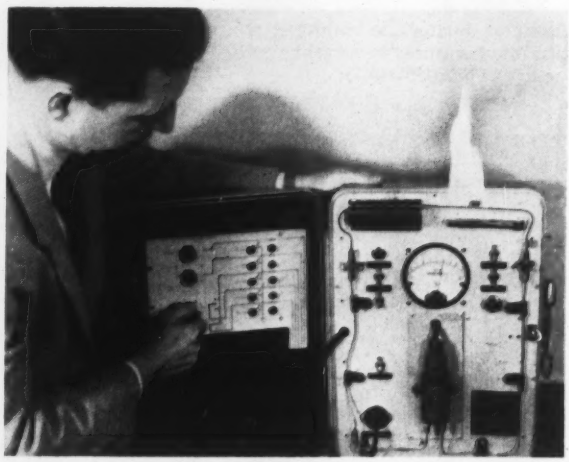
Designed around a new type of sensing element based on inorganic salts and an amplifier containing no tubes, transistors, relays, or other moving parts, this system is believed to overcome the "bugs" which have limited the acceptance of continuous detection systems. Among the features claimed for the Fenwal system are discrete sensing at a predictable temperature regardless of the length of detector exposed, virtual elimination of "averaging," and adaptability to high service temperatures. In addition the company believes the system will substantially reduce false-alarm difficulties and will require considerably less maintenance and component replacement than presently used continuous systems.

A reduction in false alarms is of major importance to both operating airlines and military aviation. For example, a number of military aircraft—mostly fighters, which are not equipped with extinguishing systems—are lost each year when pilots bail out because the detection system indicated a fire or overheat condition. In many instances, when the wreckage could be recovered and examined, no evidence of fire in flight could be found and the conclusion was that the detection systems had malfunctioned.

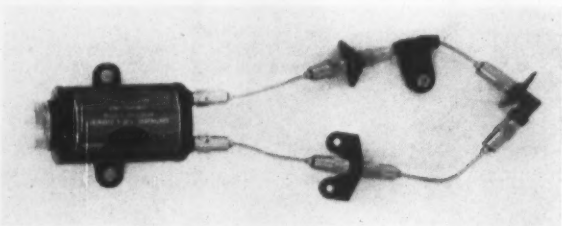
The two primary components of the new detection system are: The temperature sensing element, which is installed as a continuous cable around or through the protected zone; a magnetic amplifier control unit which is connected to the detector loop and senses electrical changes in the detector when an overtemperature condition occurs. The output of the control unit operates alarm lights and, when desired, an auxiliary relay to actuate other warning or emergency devices.

The detector elements are supplied in various modular lengths with pin-type male connectors at each end. The individual sections are connected together by means of fixed female connectors to make up a continuous loop of the required length. The detector is also supported wherever necessary by grommets and fail-safe mounting clips installed on any convenient surface. The detector is quite flexible; it can be shaped by hand to avoid obstructions and will follow contours no larger than a pencil diameter. Up to 100 ft of detector (or more, in certain cases) can be served by one control unit. The connected system forms its own electrical circuit and requires no separate wiring except that needed for auxiliary equipment.

The detector element consists of a seamless tube with a nickel wire conductor running through its center. A mixture of specially developed inorganic salts acts as the insulation between the inner wire and outer tube. During normal monitoring operation the center wire carries a low-voltage a-c current impressed on it by the control unit which is connected to the aircraft electrical system. When an overtemperature condition occurs, the



H. L. Hansberry, Fenwal's chief test engineer, uses portable conflagration to demonstrate discrete sensing characteristics of the new continuous detection system. Demonstration shows that the system signals the overheat condition (flame) at the same temperature regardless of whether the heater (under perforated shield) is on or off. Response accuracy is therefore unaffected by variable ambient temperatures along the loop or by the length of detector exposed.



Mock-up of detection loop illustrates control unit, detector elements, three types of connectors, and mounting clip

resistance of the salt filler drops sharply, permitting a large increase current between the inner wire and outer tube. This current change is sensed by the control unit which produces the output signal to actuate the warning circuit.

Fenwal has developed a large family of salt combinations for service over a wide temperature range, including temperatures well above present engine requirements. Detectors can be produced for operation at any temperature from 350 to 1200 F, which is substantially above the top limits of presently available systems. Detectors for use at 2000 F are under development.

The outer sheath of the detector is an Inconel tube, 0.088 in. in diam. All metal-to-metal bonds are heliarc welded, and the ceramic hermetic seal in the end fittings is brazed with pure silver. The detector weighs 0.016 lb per linear ft, and the end fittings 0.019 lb each. Three types of connectors are offered: A straight surface-mounted connector, a straight bulkhead connector, and 90-deg bulkhead connector. These range in weight from 0.017 lb to 0.034 lb each.

Automated Precipitator

A NEW electronic development of Research-Cottrell, Inc., has brought complete automation to the power supplies of electrostatic gas-cleaning systems.

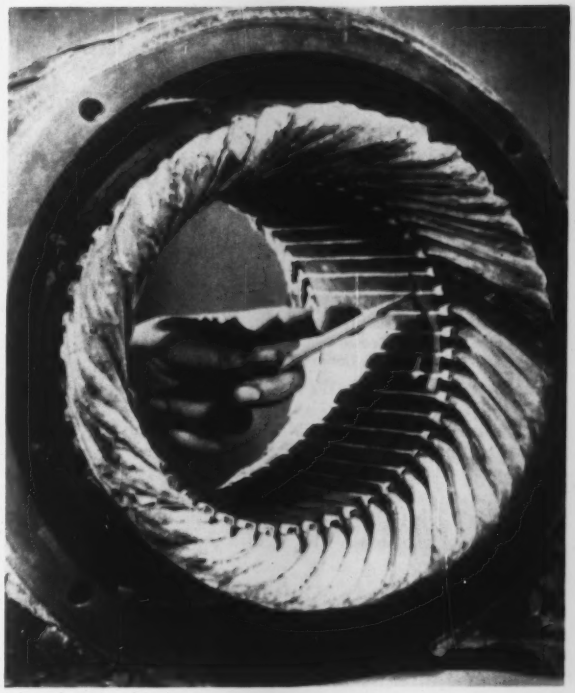
The new control system functions by continuously monitoring and readjusting spark rate to maintain optimum voltage and power input which vary with changing precipitator conditions, such as temperature, flow rate, composition, and humidity of the gas being treated, and size and resistivity of the particles being removed. Previously, adjustment of each electrical set in a precipitator installation was made manually by an operator at a control panel. For maximum efficiency and economy, this required the supervision of an expert, experienced operator controlling a multitude of knobs, meters, and panels. In some instances, as many as six electrical sets had to be manually adjusted by operators and interrelated 24 hours a day.

Even with three shifts of full-time operators, it was impossible to detect changes and make manual adjustments fast enough to keep pace with changing conditions in each area of operation. Full automation of the electrical control systems solves this problem. With the Cottrell automation system an operator with little knowledge of the equipment can start an entire gas-cleaning system, which will then operate continuously around the clock at maximum possible collection efficiency.

Silicone Insulation

ONE of the longest and most fundamental motor-testing programs in industry, undertaken to determine the maximum life of silicone insulation in motors, has reached the semifinals. After the equivalent of 5787 years, the seventh of eight much-abused motors has finally broken down. The eighth motor is still running, and in theory at least, may go on forever. The program began in October, 1943, as a joint project of Dow Corning Corporation and Westinghouse Electric.

Practical usefulness of silicone insulation has been demonstrated so effectively that the AIEE has recog-



The seventh of eight motors in Dow Corning and Westinghouse Electric's test of silicone insulation failed because the heat-warped rotor dragged on the stator. The pencil indicates where the rubbing pulled laminations until one pinched through a slot. The original silicone varnish has evolved into something like glass, but its bond strength, insulation resistance, and water-repellency are still good.

nized silicone as "Class H" (for "High Temperature").

The "failure mechanism" of silicone insulation is different from that of organic materials. Even after the varnish has crazed, it still maintains a good bond, holding the other components in place. It never evolves into a conductor, because of its silica backbone, and it stays hydrophobic.

It is doubtful, of course, that any motor could operate 5000 years, if only for physical reasons not related to insulation. Copper oxidation is solely responsible for all the breakdowns in the test except the last one where excess heat warped the rotor until it rubbed the stator, pulling stator laminations until one pinched through a slot and wire insulation.

Electric Energy Production

PRODUCTION of energy by electric utilities in the United States during 1956 reached a record of 600,591,539,000 kwhr, while production during December set a new monthly high, according to the Federal Power Commission.

Out of the record total for the year, hydro plants generated 122,012,867,000 kwhr or 20.3 per cent, and fuel-burning plants accounted for 478,578,672,000 kwhr or 79.7 per cent of the total. Total utility production was 9.8 per cent above the previous record set in 1955. Utility hydro production was up 8.0 per cent and ther-

mal production was up to 10.3 per cent from 1955 levels.

Combined utility and industrial production for the year was 683,894,054,000 kwhr, 8.7 per cent above 1955. Industrial production also set a new record of 83,302,515,000 kwhr, 1.6 per cent above 1955 output. Year-end utility capacity was 120,435,249 kw, a gross increase of 6,640,461 kw and a net gain of 5,963,381 or 5.2 per cent during the year. Utility and industrial capacity together totaled 136,996,715 kw at the year's end.

For the month of December, production by electric utilities totaled a record of 52,875,323,000 kwhr, an increase of 1.3 per cent over the previous record high of 52,194,257,000 kwhr produced in August 1956. The December total was 4.1 per cent above the 50,815,056,000 kwhr produced in December, 1955.

Water-power plants produced 9,997,502,000 kwhr in December, 7.0 per cent above production from this source in December, 1955. As a proportion of the December total, water-power output increased from 18.4 per cent in 1955 to 18.9 per cent in 1956. Production by fuel-burning plants in December, 1956, was 3.4 per cent above December, 1955.

Industrial production, including generation by railway and railroad plants, was 7,179,596,000 kwhr in December, a 0.1 per cent increase over the similar month a year earlier. Industrial-generating capacity was 16,561,466 kw on December 31, on the basis of preliminary studies.

Combined utility and industrial production in December was 60,054,919,000 kwhr, an increase of 3.6 per cent over December, 1955.

Machine-Tool Shipments

Shipments of metal-cutting machine tools for 1956 totaled approximately $885,000,000 as compared to $670,400,000 for 1955, according to *Machine Tool Progress*, Dec. 27, 1956.

Net new orders received in 1955 totaled $927,100,000—an amount considerably in excess of shipments. According to present indications, total net new orders for 1956 approximately equaled the 1955 figure.

The industry at year end had a backlog of about seven months at current rate of operations.

The picture is on the whole one of sustained demand and stability of operations. The peak of net new orders in the fall of 1955 reflected the stimulus provided by the Machine Tool Show held in Chicago in September of that year.

In 1956 rated orders for national defense accounted for only 7 per cent of shipments, and foreign orders for only 8 per cent; 85 per cent therefore represented domestic peacetime business. And yet total shipments for 1956 were only $7,000,000 below those for 1954, when the defense demand resulting from the Korean crisis accounted for a large share of the industry's output.

While it can hardly be said that two years' experience constitutes a trend, the figures nevertheless do show conclusively that a high level of operations in the machine-tool industry can be founded primarily upon peacetime demand and that there has been a very satisfactory element of stability in peacetime business.

Stability is further evidenced by the fact that no one particular industry, or no one major industrial segment, contributed in particular to the sustained volume of machine-tool sales. Continuing orders reflected in part the expansion plans of industry in general, requiring new machines for new plants, but reflected to an even greater extent the growing realization throughout all types of metal-cutting industries that obsolete machines must be replaced by the latest more efficient models in order to secure the manufacturing economies so imperatively demanded under our competitive system. Apparently American industry, on the whole, is planning to turn out greater volume—but at lower cost.

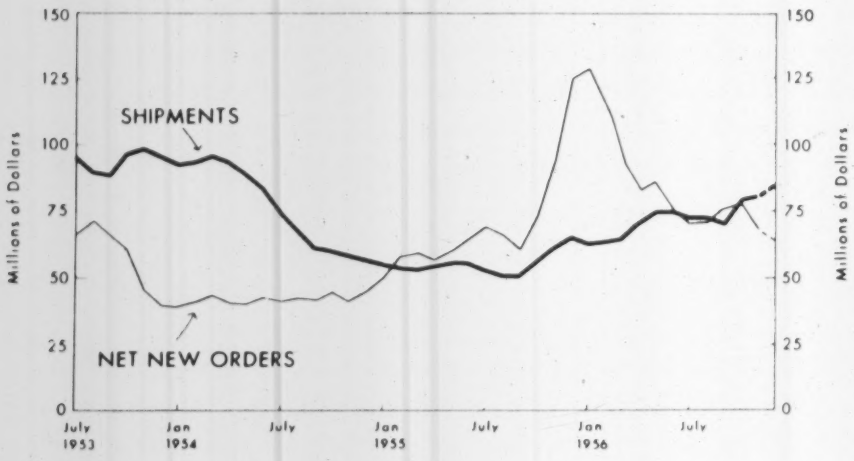
From the foregoing it would seem reasonable to expect that, barring unforeseen circumstances, machine tool shipments of metal-cutting machine tools for 1957 will at least equal, if not exceed, the total for 1956.

Steel Capacity Record

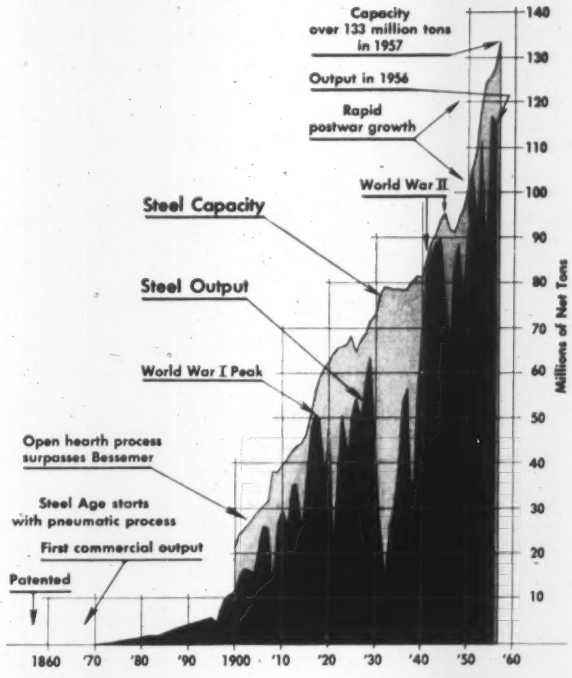
The iron and steel industry sharply increased its capacity last year to a record 133,459,150 net tons of ingots and steel for castings annually, according to *Steel Facts*, February, 1957.

This figure, which became effective January 1, 1957, was a gain of nearly 5.1 million tons in one year.

By operating at about 87 per cent of its new rated



Machine-tool shipments and net new orders—three months' moving average, plotted on the third month. Source: National Machine Tool Builders' Association.



Annual steelmaking capacity and production, as compiled by *Steel Facts*

capacity, the industry can now pour about as much steel as it did in record 1955.

The expansion will continue during 1957 and future years. One year ago the companies announced programs totaling about 15 million tons of additional capacity to be installed over a three-year period. The industry must meet the requirements of a bigger population. Currently it faces heavy demands for shipbuilding, highway construction, freight-car building, pipelines and oil wells, automobiles, machinery, school buildings, and many other needs. At the same time, it must also provide increasing amounts and improved types of steel necessary to further the progress being made in electronics, jet planes, power plants, automation, and other fields.

This is the tenth year in a row that steelmaking capacity has been increased. Today, steelmakers are able to produce 42 million tons more per year than at the end of World War II, an almost unbelievable capacity gain of 45 per cent in the comparatively brief postwar period. During that time, steel companies accomplished the three largest annual capacity boosts in the industry's history: 8.9 million tons in 1952, 6.8 million tons in 1953, and 5.1 million tons last year. This, in spite of the fact that construction and equipment costs are at a new high.

Supporting the rise in steelmaking capacity, blast-furnace capacity went up 1.3 million tons during the past year to a January 1, 1957, rating of 86.8 million tons annually. Similarly, coke-oven capacity gained 1.4 million tons over the past year, standing now at 72.9 million tons a year. Finishing-mill facilities have also been expanded and improved, while much has been done to increase the supply of raw materials.

The steelmaking capacity of the industry is now located in 28 states, as compared to 27 formerly, with Mississippi the newest addition. The capacity increase last year was spread out over 15 states. Ohio, the second largest steelmaking state, registered the biggest boost with a capacity jump of more than 1.7 million tons of ingots and steel for castings.

Nuclear Briefs

▶ AEC Radiation Regulation

THE AEC has issued in final form the regulation which has been under consideration since July, 1955, establishing standards for the protection of atomic energy workers and the public against radiation hazards arising from the activities licensed by the Commission.

The permissible weekly dose for various portions of the body is specified. The maximum for the hands and forearms, feet and ankles, or head and neck, is 1500 millirem for any radiation, provided the exposure of these limited portions does not alter the total weekly dose to the bloodforming organs in the main portion of the body, to the gonads, or to the lens of the eye. The total permissible weekly dose for these critical organs is 300 mrem. The permissible exposure for the skin at the basal layer of epidermis is 600 mrem for any radiation with half-value layer greater than 1 mm of soft tissue.

The permissible concentrations of various isotopes with their airborne radioactive material in restricted areas to which personnel would be exposed from the possession, use, or transfer, of licensed materials, and also for hazards to the public from the release of radioactive effluents to unrestricted areas are also defined. Permissible amounts of each isotope are listed separately.

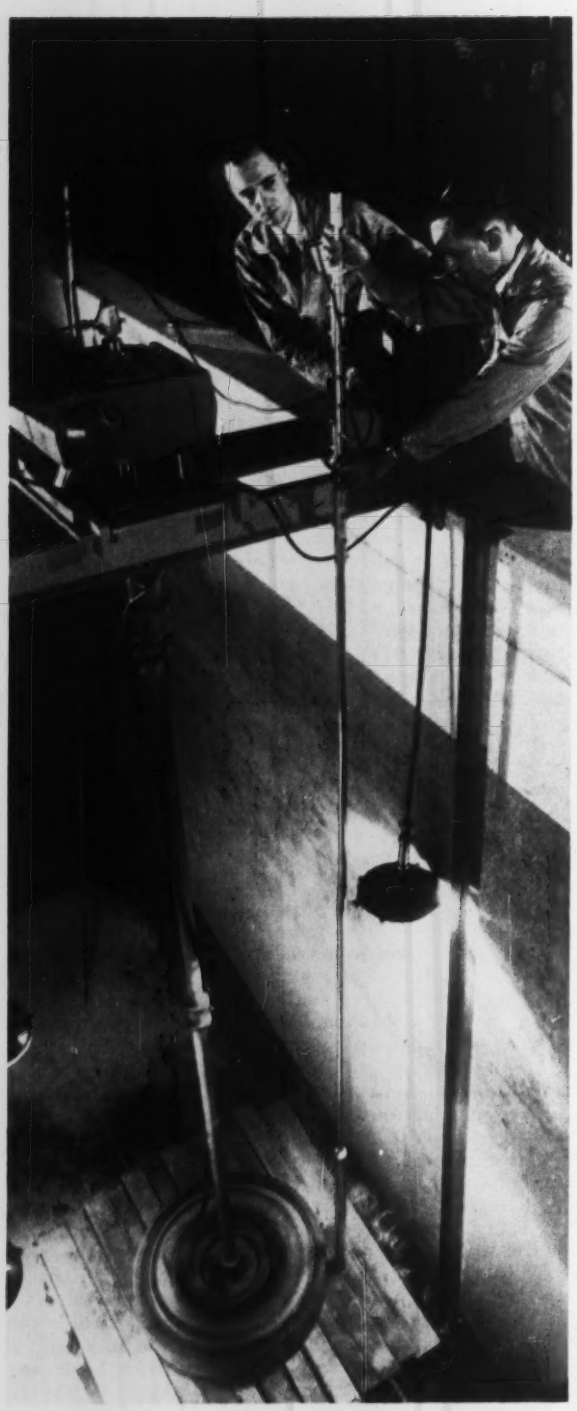
▶ Increased Availability of Boron-10

Kilogram quantities of the isotope boron-10 are being made available for sale by the Atomic Energy Commission for use in the civilian atomic-energy program. Since boron-10 has the nuclear property of readily absorbing neutrons without itself becoming radioactive, it is particularly suitable for use in nuclear-reactor shielding and control mechanisms, and also can be employed in radiation-measurement instruments.

Boron exists in nature as a mixture of two isotopes, the isotope boron-10 constitutes 19.8 per cent of natural boron, with the remainder being the isotope boron-11, which does not readily absorb neutrons. Therefore in many applications it is desirable to separate the boron-10 from boron-11. In most instances the separated boron-10 or, more specifically, material enriched in the boron-10 isotope, is then processed into metal.

Some AEC programs are already using enriched boron. However, nongovernment uses have in the past been very limited, since only gram quantities have been supplied under the Commission's Isotope Distribution Program.

Less than three pounds a day are produced by a staff of approximately 115 men and women on a three-shift basis at a plant operated for the AEC by Hooker Electrochemical Company at Model City, N. Y., near Hooker's headquarters at Niagara Falls, and the metal is valued at nearly three times the price of refined gold.



Vulcanizing a tire without heat at the Nuclear Reactor Testing Station, Idaho. B. F. Goodrich Company scientists slowly rotated the tire, encased in a steel mold, over radioactive fuel elements. The nuclear vulcanization which produces a tire with longer life was done under 17 ft of water for protection from radiation. Experiments with nuclear vulcanization have been conducted by the company since 1927, and the first patent was obtained in 1933.

▶ Nuclear Vulcanization

Vulcanization without heat is another practical use of nuclear radiation developed at the AEC's National Reactor Testing Station in Idaho. The process was perfected at the NRTS by B. F. Goodrich scientists whose research in company laboratories dates from 1927 when the first small samples of rubber were vulcanized in a process on which a patent was granted in 1933.

The adaptation to the practical problem of vulcanizing a tire was made by placing the tire, in a steel mold, over radioactive fuel elements from the reactor and rotating it slowly. As a protection against radiation this was done in a 17-ft-deep water-filled canal at the NRTS Material Testing Reactor Gamma Facility.

Nuclear vulcanization results in a direct linkage of the carbon atom chains of the rubber molecules. In ordinary vulcanization, which has been in use without basic modification since 1839, these are linked through sulphur atoms, and this is the "weak link" in vulcanizing rubber. In addition to proving the practicability of vulcanizing large items by nuclear radiation, the experiment produced a tire expected to wear longer and resist deterioration better than those vulcanized by conventional means.

▶ AEC Offers Processing Service

Pending the establishment of commercial services to do the work, the AEC has established a policy of providing chemical-processing services for the operators of private nuclear reactors. The purpose of the new policy is to give further encouragement to the development of a private atomic-energy industry by giving licensed reactor operators an assured means for recovering the valuable constituents which remain in spent fuel elements after their removal from the reactors.

The AEC offers to contract with the reactor owners for the chemical processing and recovery of source and special nuclear material as well as the safe disposal of waste materials. Individually negotiated contracts will establish firm charges for the service, subject to escalation on the basis of an appropriate price index, and cancellation by the AEC, after giving 12 months' notice, upon a determination that the services will be commercially available at reasonable prices.

▶ Industrial Nuclear Research Center

A nuclear research center in Sterling Forest, Orange County, N. Y., about 40 miles from New York City, is planned by Union Carbide and Carbon Corporation. The major facilities on the site will include: A five-megawatt pool-type reactor which will be a modified version of the Bulk Shield Testing Facility at the Oak Ridge National Laboratory; a radioactive materials laboratory for remotely controlled high-level experiments with radioactive materials; an ores and engineering laboratory for research and pilot-plant operation covering the entire range of activities from mineralogy and geology to new mineral-prospecting methods, as well as work in geophysics and geochemistry; and a building for allied research operations and administrative functions. Research programs will be geared to the study of the effects of radiation on products and processes involving plastics, gases, metals, carbons, and chemicals.

▶ Package Power Plant

A 15-ton 4-ft-diam 8-ft-long cylindrical pressure vessel, which will contain the nuclear fuel in the 2000-electrical-kw Army Package Power Reactor, has been set in the plant at the Corps of Engineers' Research and Development Laboratories, Fort Belvoir, Va.

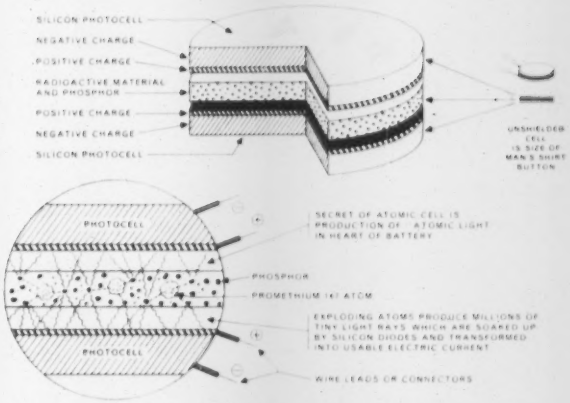
The circulating-pressurized-water-reactor plant is a prototype of "package" power reactors being developed jointly by the Defense Department and the AEC for use at remote bases to eliminate the need for transporting bulky conventional fuels. All components of such plants will be air-transportable, may reduce wartime demands for conventional fuel, conserve manpower and materials, and help ease restrictions on domestic consumption. Succeeding plants for remote bases are expected to produce heat for space heating in addition to electricity.

▶ Controlled Recirculation Boiling Reactor

An advanced nuclear power concept, the Controlled Recirculation Boiling Reactor (CRBR), designed by Allis-Chalmers Manufacturing Company of Milwaukee, Wis., will be used to build a $20-million to $25-million 60,000-kw nuclear power plant. Northern States Power Company organized by a group of midwestern utility companies will be the builder and operator.

The 5 × 5-ft cylindrical core will produce 133 mw of heat. The CRBR will operate at 600 psi 488 F and produce steam that will be superheated with conventional fuel to increase the temperature to 1000 F at 540 psi.

This modification of the boiling-water reactor has an unusually high energy output per unit of volume because of the large quantity of water being recirculated continuously. Although the core is only 1 ft larger in each direction than that of the Experimental Boiling Water Reactor (EBWR) at the Argonne National Laboratory, Lemont, Ill., and the reactor vessel 2 ft greater in ID, 2 ft less in height, the electric power produced is 12 times as great. Forced-circulation experiments are also planned at the EBWR, and any direct comparison, however, should consider the cost and contribution of the fuel used for superheating.


SILICON PHOTOCELL
NEGATIVE CHARGE
POSITIVE CHARGE
RADIOACTIVE MATERIAL AND PHOSPHOR
POSITIVE CHARGE
NEGATIVE CHARGE
SILICON PHOTOCELL
UNSHIELDED CELL IS SIZE OF MAN'S SHIRT BUTTON
PHOTOCELL
SECRET OF ATOMIC CELL IS PRODUCTION OF "ATOMIC LIGHT" IN HEART OF BATTERY
PHOSPHOR
PROMETHIUM 147 ATOM
EXPLODING ATOMS PRODUCE MILLIONS OF TINY LIGHT RAYS WHICH ARE SOAKED UP BY SILICON DIODES AND TRANSFORMED INTO USABLE ELECTRIC CURRENT
PHOTOCELL
WIRE LEADS OR CONNECTORS

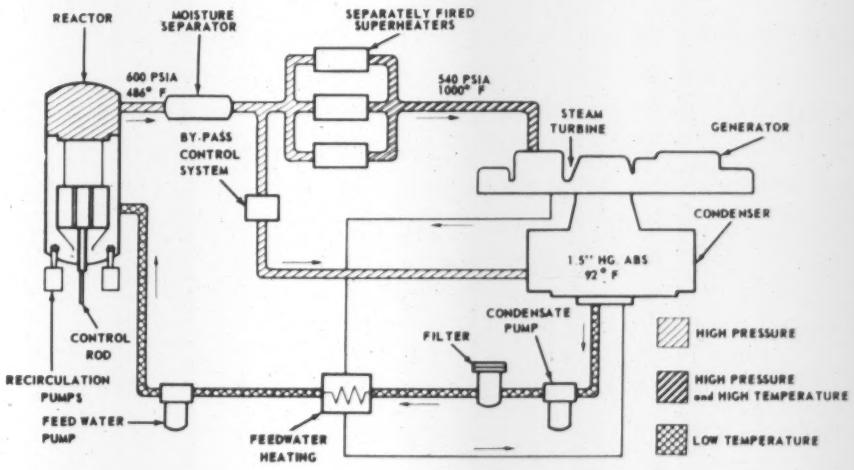
Nuclear material is converted directly into electricity in two steps in this nuclear battery. Beta emissions are converted to light and from light to electricity in silicon cells of the solar type.

▶ Nuclear Battery

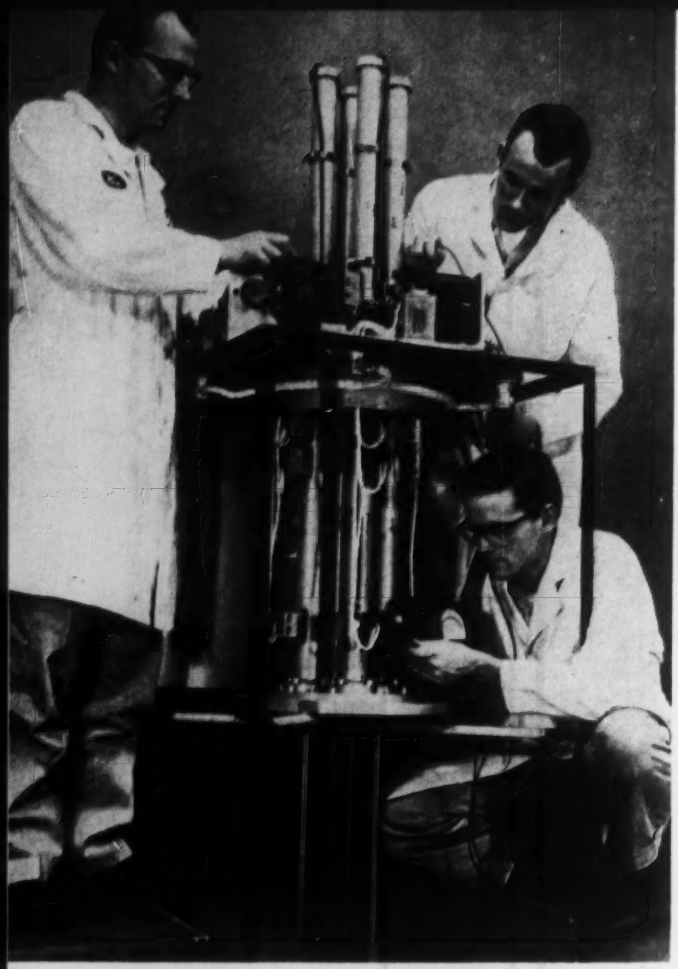
A nuclear powered battery the size of a shirt button, capable of delivering continuous electric power for at least five years has been developed by Elgin Watch Company and Walter Kidde Nuclear Laboratories, Inc.

The battery depends upon a two-step conversion of energy from beta emissions to light and from light to electricity in silicon cells of the solar type. The light source in the prototype consists of a mixture of about 50 mg of finely divided phosphor and about 5 mg of an oxide of promethium-147. The 4½ curies of the latter which it uses will be available at 50¢ per curie when a new AEC plant is completed. Nominal power output is 20 microwatts when new, 10 after 2½ years, and 5 after about five years. Larger area cells can be built for greater output, or cells can be used in series.

A case of dense metal makes the battery perfectly safe for personal use in such applications as electric wrist watches. Unaffected by extreme environmental conditions, it can also be used in high-altitude missile and rocket work, and in scientific deep-space experiments.



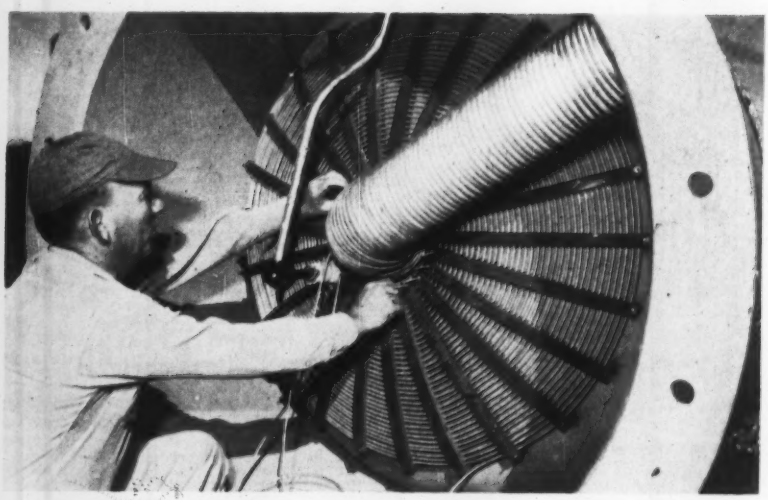
Flow-diagram—Allis-Chalmers controlled recirculation boiling reactor



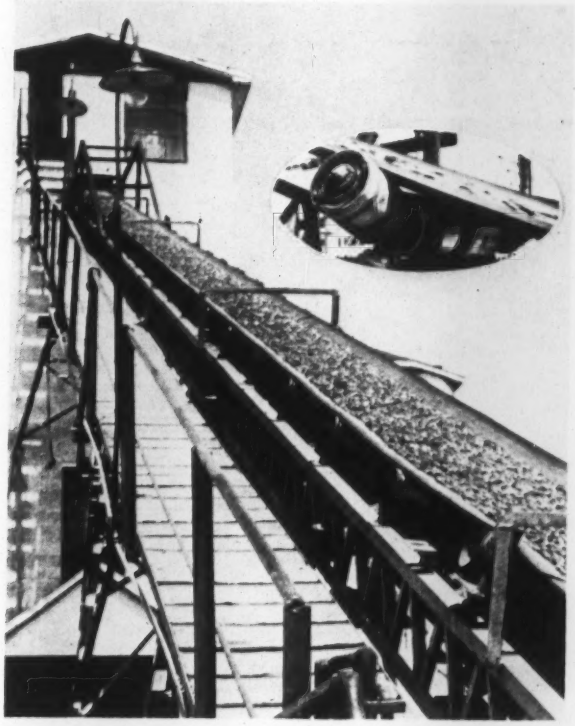
Reactor Component Checkout. Final checkout of the control-rod-drive assembly for the 50-kw solution-type research reactor built by Atomics International, a division of North American Aviation, Inc., Los Angeles, Calif., for the Japanese Atomic Energy Research Institute.

Metallurgical Filter Bags. Filter bags woven of monofilaments made from Bakelite polyethylene, last almost 7 times as long as conventional filter bags used in the metallurgical industry. Polyethylene has withstood moisture, corrosive atmosphere, and blinding by slime particles or chemical precipitation. Bags are made in segment shapes which together form a huge disk against which liquid and particles in suspension are drawn by vacuum. The evenness with which moisture is drawn through the cloth pores, *bottom right*, results in greater filter efficiency and savings in filter downtime.

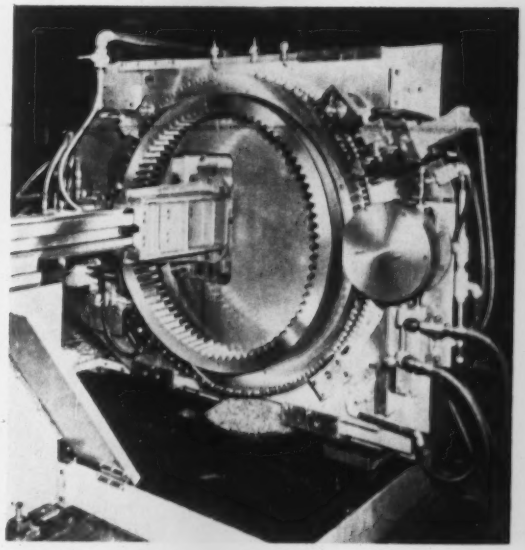
Photo



Reactor Installation. Induction heating coils being installed on the bottom of the main core vessel of the Organic Moderated Reactor Experiment (OMRE), an experimental nuclear power reactor being built by Atomics International for the AEC's National Reactor Testing Station at Arco, Idaho. Completion of OMRE is expected this year.

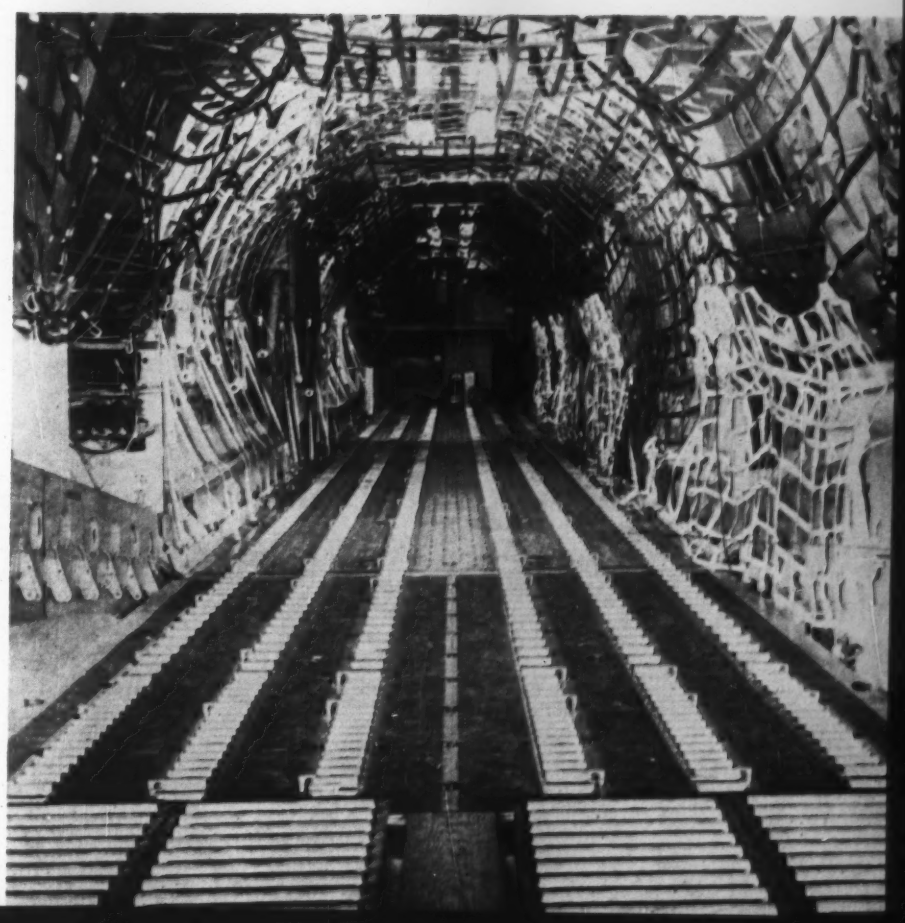


Conveyer Bearings. Oilite, unsealed bronze sleeve bearings produced by the Amplex Division of the Chrysler Corporation, have served 7 years without replacement in the dust and grime which this gravel conveyer produces.



Horizontal Broaching Machine. Finished spur or semifinished helical gears up to 42 in. pitch diam are broached by this universal horizontal broaching machine made by Colonial Broach & Machine Company, Detroit, Mich. Tooth-cutting is reduced from an all-day job to an hour and a half with gears broached in two passes —a roughing cut and a finishing cut.

Briefs



Speedy Ground Handling. By using roller conveyers on the loading dock and temporary units which can be installed in the plane in five minutes, air cargo can be handled on the ground at speeds comparable to the saving in time accomplished in the air. Specialized cargo nets are dropped over the cargo after it is in place to accomplish rapid tie-down.

European Survey

Engineering Progress in the British Isles and Western Europe

J. Foster Petree,[1] Mem. ASME, *European Correspondent*

Double Pelton wheel, 30,000-kw generator recently installed at Finlarig Power Station, Scotland

Double Pelton Wheel Generator

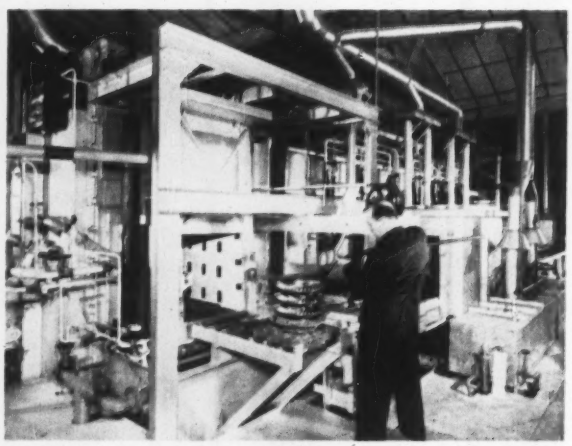
THE water-power resources of the British Isles are not comparable with those in the more mountainous countries of Europe, but steady progress is being made in Scotland in the utilization of available power. At Finlarig, on the shore of Loch Tay, the North of Scotland Hydro-Electric Board has installed a generating set which is notable among British plants in using a head of 1360 ft, the highest so far applied in the country, and the largest horizontal set yet commissioned in the British Isles. The 30,000-kw alternator, constructed by the British Thomson-Houston Company, Limited, at Rugby, England, is driven at 375 rpm by two Pelton wheels, supplied by Boving Limited, one on each end of the generator shaft, giving a combined output of 42,000 hp. Each wheel is driven by two jets, from nozzles $7\frac{1}{2}$ in. in diam, from which the water issues at a velocity of nearly 280 fps. The load imposed on each bucket of the wheels is approximately 20 tons. The water is obtained from a small loch, into which various small rivers from Ben Lawers and other hills in the neighborhood have been diverted. It lies at about 1620 ft above sea level, and has been raised 90 ft by a buttress dam at the southern end. A tunnel two miles long carries the water to the valve house, which is connected to the power house by a high-pressure steel pipeline.

[1] Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.

Gas Carburizing Furnace

THE E.N.V. Engineering Company, Limited, London, England, specializes in the manufacture of precision gears for the automobile, aircraft, and other industries. To speed up the production of these gears they have recently installed a continuous carburizing furnace, constructed by Birlec Limited, Erdington, Birmingham, England which presents some interesting features. It is heated by gas-fired radiant tubes, arranged transversely above and below the conveyers, and has an output of more than 40 tons per week of 168 hours, with a gas consumption of about 4200 cu ft per hr. The gas used is produced from propane in Birlec endothermic generators, of which there are three, one serving the main furnace chamber, a second serving the charging and delivery lock chambers at the ends, and the third being kept in reserve as a standby. The two generators in use at any time require about 160 cu ft per hr of propane for an output of ten times that quantity of furnace gas continuously supplied, plus a periodic extra amount of 1000 cu ft per hr for purging the lock chambers.

The material to be treated consists mainly of automobile transmission gears which are loaded on heat-resisting trays 18 in. square and moved through the furnace on three parallel tracks. Each tray carries up to 150 lb of gears, which may be stacked on it, or in some cases, mounted on special fixtures. They circulate continuously through the furnace and back along the reloading track, so that hand labor is confined to the re-



Gas carburizing furnace. View of the discharge end of the furnace with vestibule outer door open and operator using special tongs to transfer crown wheels to quenching press.

moval of finished work and reloading with fresh parts. All work is cleaned in a washing machine before loading. The operation of the furnace is so simplified by automatic control that two men can maintain it at full output, as well as handling the washing process before loading and the tempering which follows the case hardening. Charging is normally carried out after every third cycle, when each track has moved once. Each track has an individual timer, which rings a bell and also lights an indicator at the set push intervals. The automatic sequence is then started by push-button.

This automatic sequence is as follows: The inner charge door opens and the new tray on a given track is pushed from the lock chamber into the furnace, moving the whole track one tray forward and bringing the foremost tray up to an extractor. The quench elevator then rises, the inner discharge door opens, and the foremost tray is pushed sideways into the discharge chamber. The inner discharge door then closes, the elevator descends, and the tray is immersed in a rapidly moving vertical oil stream for a pre-set time; after which the tray moves sideways in the quenching tank and is elevated to the discharge position, pushed on to the discharge track, and through the washing machine to unloading position. The empty tray goes on for reloading.

A battery of quenching presses is located near the discharge end of the furnace. If the work requires press-quenching, a switch is operated which interrupts the automatic sequence when the full tray is in the discharge lock. The closing of the inner discharge door to seal the chamber operates a signal, after which the outer door can be opened and the work extracted. The re-closing of the outer door sets the normal cycle in automatic operation again. Whenever a lock chamber is opened to atmosphere, the gas within it burns away. As the outer door is closed, therefore, the generator providing purge gas automatically feeds in gas for a pre-set time to sweep out the air and the burnt gas.

The depth of the case-hardening is controlled, as usual, by both furnace temperature and soaking time, and the carbon content of the case by the composition of the atmosphere within the furnace. To regulate the carburizing temperature to the best advantage, the furnace is divided into four heating zones, each with an independent automatic control. The first raises the charge to the predetermined temperature. In the second and third, this is maintained, while gas circulating fans ensure uniform treatment. In the final zone, the temperature of the load is reduced to a level most suitable for quenching; or, if necessary, it may be increased. A range of case depths from 0.03 in. to 0.06 in. can be obtained by varying the cycle time. Normally, a minimum track cycle time of 27 min is used, corresponding to 9 hr total time for each tray in the furnace. The automatic controls provide for independent cycle timing on each of the three tracks, to produce different case depths concurrently. Plant floor space is only 49 ft × 25 ft, though the furnace heating chamber is 31 ft long.

6000-Ton Wheel Press

Duncan Stewart & Company, Limited, Glasgow, Scotland, who are associated with the Davy and United Engineering Company, Park Iron Works, Sheffield, England, have recently supplied a 6000-ton press for forging railway car wheels to the Société Anonyme des Aciéries et Forges de Firminy, whose works, the Usine des Dunes, is situated near Dunkirk, France. It produces solid wheels of monobloc form—that is, with the tire forged as part of the wheel—up to 45 in. diam in five operations, the whole process taking about 1½ min. The first operation is to place the 1500-lb hot ingot on the slabbing anvil, where it is centered by hydraulic gripping gear and drawn under the press. A swinging arm carrying the top roughing tool is then brought into position and the press crosshead is lowered onto the ingot for the first squeeze. The ingot having been reduced to the required thickness, the forming tool is moved under the ram and the wheel is pressed to its final form. The hub is then punched through—two punches being required for this operation—and the wheel is removed from the press by a floor-type manipulator. The finishing process is carried out in a wheel-rolling mill, which forms the flange and the tread, and brings the diameter up to the specified limits. The wheels are sent from the press to the mill in the same heat, so that an output of 35 finished wheels per hour is readily maintained. Two 600-hp hydraulic pumps provide the pressure, with a 400-gal air-hydraulic accumulator in the delivery line.

6000-ton press for French steelworks. The press produces solid railway car wheels of 45-in. maximum diam in five operations taking about 1½ min.

ASME Technical Digest

Substance in Brief of Papers Presented at ASME Meetings

Heat Transfer

Effects of Junction Manufacture on Thermocouple EMF Generation, by Dr. Erich A. Farber, Mem. ASME, University of Florida, Gainesville, Fla., and M. R. Glickstein, Assoc. Mem. ASME, University of Illinois, Urbana, Ill. 1956 ASME Annual Meeting paper No. **56—A-135** (multilithographed; available to Oct. 1, 1957).

THIS investigation indicates that calibrations of a thermocouple with one type of junction cannot be used for another thermocouple of the same thermoelements but joined by a different process.

Eight thermocouples were tested, all copper-constantan, each from the same spool, but with the wires joined by different methods—welding, brazing, soldering and, in one case, twisting the wires together. Under identical conditions, temperatures indicated by the eight thermocouples differed by as much as 2 F.

Curves are presented, showing not only the variations due to differences of junction manufacture, but also the different aging characteristics of the various thermocouples. It is also shown that the variations are of different amounts at different temperatures.

Included are photomicrographs of thermocouple junctions, showing structural differences produced by the various methods of juncture.

Compilation of Radiation Shape Factors for Cylindrical Assemblies, by H. Leuenberger and R. A. Person, Assoc. Mem. ASME, Electro Metallurgical Co., a Div. of Union Carbide & Carbon Corp., Niagara Falls, N. Y. 1956 ASME Annual Meeting paper No. **56—A-144** (multilithographed; available to Oct. 1, 1957).

FOR the design of furnaces, kilns, reactors, driers, and other process equipment of cylindrical shape in which radiant heat interchange can be significant, it is advantageous to have complete knowledge of geometric "shape factors," to assess the radiant heat interchange. The term shape factor is defined as the fraction of the total radiation leaving one surface in all directions which is intercepted by the other surface.

The report discusses the method of deriving a shape factor for a pair of surfaces by setting up a differential form. Analytical expressions for various cylindrical arrangements are obtained and tabulated. The 14 pages of tabulation can be considered a dictionary of shape factors for cylindrical assemblies.

Heat Transfer by Radiation From Flames, by R. A. Sherman, Fellow ASME, Battelle Memorial Institute, Columbus, Ohio. 1956 ASME Annual Meeting paper No. **56—A-111** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1957).

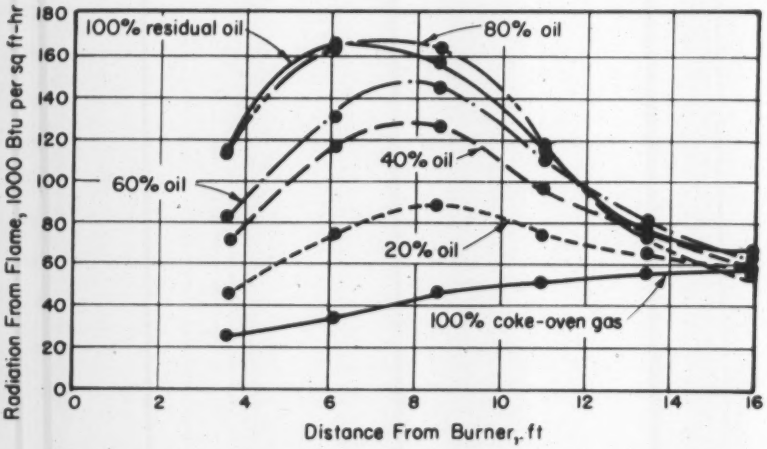
A UNIQUE example of international co-operation appears in the program of "research on radiation from flames" that is being conducted at the Royal Netherlands Blast Furnace and Steel Works, at IJmuiden, Holland. It is unique because it arose from spontaneous activity on the part of scientists and engineers, without governmental action. The International Flame Research Foundation has been registered in Holland, a nonprofit organization, governed by a Joint Committee of representatives from six nations, including the United States.

This paper outlines the organization of the work, the experimental facilities, the methods of research; it also presents the results of the Foundation's first studies of flame radiation.

Two general classes of tests have been made: (*a*) "performance," or "industrial" tests, and (*b*) "combustion mechanism," or "scientific" tests. Performance tests are to determine the effects of certain variables, such as type of fuel, type of burner, type of atomizing agent, degree of mixing air, excess of air, and rate of heat input, on the radiating characteristics of the flame. Results of such tests are intended for immediate application in industrial furnaces.

Combustion-mechanism tests are to examine flames in considerable detail. For example, the rate of mixing and the appearance and disappearance of carbon in the flame are studied both longitudinally and laterally and, by measuring the radiation of small elements of the flames, an attempt is made to relate the carbon content and the radiating characteristics of the flame.

To obtain data on the radiating characteristics of the flames, a series of ports in the form of vertical slots is provided in one wall of each furnace. By an ingenious arrangement, the radiometers can be moved up or down for a vertical traverse of the flame, and the ports can



The curves show the radiation from flame of coke-oven gas carburetted with varying percentages of residual oil, results of one of the early tests. The percentages of each fuel were calculated on the basis of the heat value that each contributed to the total.

be closed to avoid the inleakage of air.

Three types of radiometers have been built and used. One consists of a thermopile mounted on the end of a water-cooled tube which contains a series of diaphragms to limit the field of view of the thermopile. The second type uses a fixed-focus rhodium-plated mirror to reflect the radiation onto a thermopile. A third type is based on this same principle but is designed to measure radiation from two sources simultaneously. Electrically heated, tube or sphere furnaces are used at frequent intervals for purposes of calibration of the radiometers.

Fuel oils and coke-oven gas have been the fuels tested so far, but the research is now being extended to include the use of pulverized coal. As tests are run through two work shifts, with a third shift used to make necessary adjustments to equipment, procedures have been so planned as to enable a calculation of the effects, if any, of the three teams of men used to obtain the data.

The paper reports on tests in which the following variables were investigated: fuel, rate of heat input, atomizing agent, rate of supply of atomizing agent, thrust on burner, type of burner, excess of air at furnace exit, carbureting agent, amount of carburant, and temperature of combustion air. The results have been analyzed statistically, and the confidence level of each derived data point has been calculated.

The execution of the work at IJmuiden is in the hands of a Principle Investigator who was first British, then French, and is now, again British. For the experiments, in which 30 to 40 men have been required for weeks, investigators are furnished from co-operating companies in the several countries. Normally, their salaries and traveling expenses are borne by their employers; thus, the Foundation receives, in addition to cash, substantial contributions "in kind."

The instrument room at the IJmuiden laboratory. The total cost of the experimental furnaces and equipment now available was approximately $200,000. Operating costs in the year 1955, paid by the Joint Committee, were $64,000 cash, plus "in kind" amounting to another $25,000.

Shell-Side Characteristics of Shell-and-Tube Heat Exchangers, by Townsend Tinker, Mem. ASME, American Radiator & Standard Sanitary Corp., Buffalo, N. Y. 1956 ASME Annual Meeting paper No. **56—A-123** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1957).

HERE is developed a simplified rating system for commercial shell-and-tube heat exchangers. Recommended heat-transfer and friction characteristics for practical design purposes are presented, based on previously presented research data and certain findings of the ASME-University of Delaware Heat Exchanger Research Project. Where possible without serious sacrifice in accuracy, certain resistance-factor approximations and assumptions have been introduced in the interest of practical simplicity; formulas of simple form have been derived for evaluating the fluid-flow fraction through the cross-flow area of the tube bundle.

Simple tabulations of heat-transfer and pressure-drop characteristic "rating numbers" may be readily developed from these formulas for various styles or series of heat exchangers having consistent design proportions. These rating numbers permit a rapid rating of the heat-exchanger shell-side performance. The system is responsive to the major effects of unit size, tube size, tube pitch and flow orientation, baffle spacing and cut, and the principal leakage and bypass clearances of the heat-exchanger design.

The system developed is accurate within practical commercial requirements, and is very flexible, so that as more accurate resistance factors are developed by research for specific cases, they may be employed in the system for more precise results.

Heat-Transfer Characteristics of the Rotational and Axial Flow Between Concentric Cylinders, by G. Gazley, Jr., Assoc. Mem. ASME, The Rand Corporation, Santa Monica, Calif. 1956 ASME Annual Meeting paper No. **56—A-128** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1957).

THIS paper considers the convective heat-transfer characteristics of the flow in the annular gap between a rotating inner cylinder and a stationary outer cylinder. Heat-transfer measurements are reported for two gap sizes and various combinations of axial and rotational flows.

Both smooth and slotted surfaces were used. Measurements for laminar and turbulent-flow conditions followed the trends predicted by theory. An unusual feature of the results for rotational flow without axial flow is the heat-transfer rate in an intermediate flow region existing between the laminar and turbulent regimes. Here, regular ring-shaped vortexes cause a heat-transfer rate even greater than with turbulent flow.

Heat Transfer from a Rotating Disk in Turbulent Flow, by F. Kreith, Assoc. Mem. ASME, and J. H. Taylor, Jr., Lehigh University, Bethlehem, Pa., 1956 ASME Annual Meeting paper No. **56—A-146** (multilithographed; available to Oct. 1, 1957).

THE heat transfer from a rotating disk at constant temperature to a stagnant fluid is investigated analytically by means of the Reynolds analogy and by the von Karman integral method.

The analytical results are compared with experimental data obtained by Young, but the analysis does not agree

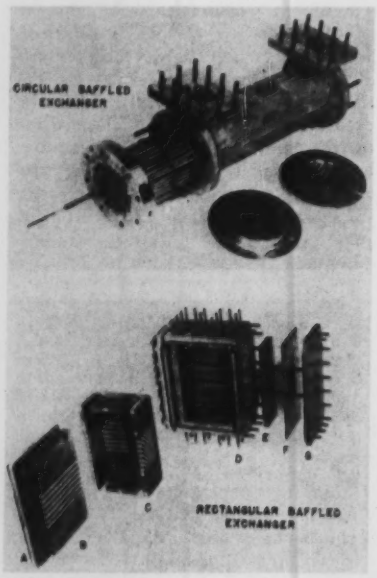
with the experimental results because the range of Reynolds numbers used in the experiments did not yield fully turbulent flow. The analyses presented in this paper permit an evaluation of the local as well as average heat-transfer coefficient at Reynolds numbers above 3×10^7 with reasonable accuracy for fluids having Prandtl numbers between 0.5 and 25. For air, the fluid of greatest practical importance, the results are presented graphically.

Heat Transfer and Fluid Friction During Flow Across Banks of Tubes, by O. P. Bergelin, Mem. ASME, and M. D. Leighton, University of Delaware, Newark, Del., and K. J. Bell, Case Institute of Technology, Cleveland 6, Ohio. 1956 ASME Annual Meeting paper No. **56—A-133** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1957).

This is a study of leakages between baffle and shell, and around the tubes, within tubular heat exchangers. Orifice coefficients are given which will permit calculation of the amount of leakage if the pressure difference across the baffle is known. Fouling is disregarded.

For the case of turbulent flow of the main stream in the exchanger, the effect of internal leakage upon pressure drop and heat transfer is shown by comparing experimental results from exchangers with known internal clearances, with the results from an exchanger with no internal clearances. Internal clearances comparable to those encountered in commercial practice were found to lower the heat-transfer coefficient to around 55 per cent, and the pressure drop to around 30 per cent of the values without internal leakage.

Graphs are presented which will aid in estimating the reduction in pressure drop and heat transfer due to internal leakages in exchangers which conform to the type studied.



Circular and rectangular models used in study of flow through multi-baffled heat exchangers

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Estimation of Temperature Patterns in Multiply Shielded Systems, by J. G. Bartas, Assoc. Mem. ASME, General Electric Company, West Lynn, Mass., and E. Mayer, ARDE Associates, Newark, N. J. 1956 ASME Annual Meeting paper No. **56—A-130** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1957).

The method of difference equations is applied to the problem of estimating temperature patterns in multiply shielded systems. The procedure yields results in terms of elementary functions which can be readily evaluated, and the paper, therefore, presents an engineering method for estimating the temperatures in a system which contains an array of thermal radiation shields.

The equations are employed to examine the effect of shield curvature, end radiation, and gas radiation on the temperature recorded by a shielded thermocouple for a variety of operating conditions. Calculations indicate that whereas shield curvature and gas radiation may be neglected in a well-designed shielded thermocouple, end radiation can result in a substantial error in the thermocouple-temperature measurement.

Heat Transfer to Laminar Boundary Layers with Variable Free-Stream Velocity, by R. A. Seban, Mem. ASME, University of California, Berkeley, Calif. 1956 ASME Annual Meeting paper No. **56—A-125** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1957).

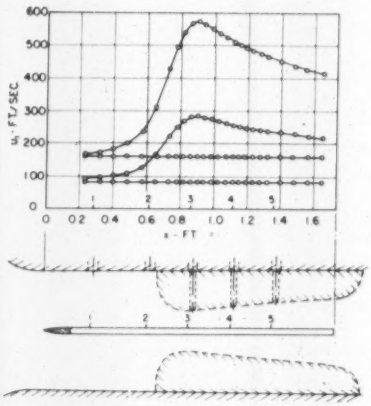
In this paper, heat-transfer coefficients are determined for the laminar boundary layer of a two-dimensional subsonic flow of air over a flat plate. By the agency of blisters attached to the wind-tunnel wall the boundary layer, formed under almost constant free-stream velocity, was subjected to a strong acceleration which produced a three to fourfold increase in the free-stream velocity, followed by a moderate deceleration. Maximum velocities ranged from 260 to 900 fps.

The heat-transfer results are correlated on the basis expected for laminar flow. It is further demonstrated that a prediction method based on constant fluid properties gives results in satisfactory correspondence with experiment.

Design of Supersonic Expansion Nozzles and Calculation of Isentropic Exponent for Chemically Reacting Gases, by R. Edse, Ohio State University, Columbus, Ohio. 1956 ASME Annual Meeting paper No. **56—A-106** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1957).

For the calculation of sonic velocities or changes in pressure, volume, or temperature in gases, the isentropic or polytropic exponent of the gas or gas mixture must be known. So far, it has been needed also for designing supersonic expansion nozzles. However, it is shown in this paper that more accurate designs of such nozzles can be obtained without the use of the isentropic or polytropic exponent. As long as no chemical reaction occurs in the gas, the isentropic exponent is equal to the ratio of the specific heat at constant pressure to that at constant volume.

However, in jet engines or in hypersonic wind tunnels using very high stagnation temperatures, the isentropic exponent is no longer identical to the ratio of the specific heats because of the energy released or absorbed by the chemical reactions. Methods are presented



Flat plate in wind tunnel, for study of heat transfer to boundary layer. Blisters on wind-tunnel wall serve to increase free-stream velocity.

for calculating differential and integral values of the isentropic exponents in gases without and with consideration of chemical reactions. A numerical evaluation of the method is given for dissociating hydrogen.

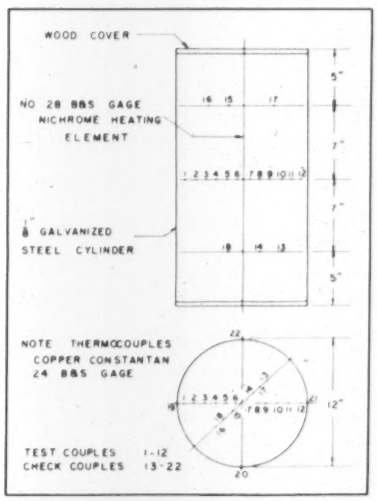
The results of this investigation indicate that the isentropic exponent of a chemically reacting gas mixture differs greatly from the ratio of the specific heats. It is also shown that accurate designs of supersonic expansion nozzles for chemically reacting gases require a detailed thermodynamic analysis of the system.

Transient Heat Flow Determination of the Thermal Properties of Clay, by E. B. Penrod, Mem. ASME, University of Kentucky, Lexington, Ky., and G. T. Privon, Carrier Corporation, Syracuse, N. Y. 1956 ASME Annual Meeting paper No. **56—A-91** (multilithographed; available to Oct. 1, 1957).

THIS paper describes a procedure in which a clay specimen, in a cylinder with a constant ambient temperature, was tested by applying heat at its center. The purpose of the test was to obtain data from which the thermal conductivity, thermal diffusivity, and specific heat of the specimen could be calculated.

With a wire serving as a heating element, and thermocouples to measure temperature, readings taken over a period of 35 hr gave the required data: (1) the time rate of change of the temperature distribution, and (2) the final temperature distribution.

The paper concludes with a discussion of the advantages and disadvantages of the method.


WOOD COVER
NO. 28 B&S GAGE NICHROME HEATING ELEMENT
8" GALVANIZED STEEL CYLINDER
NOTE THERMOCOUPLES COPPER CONSTANTAN 24 B&S GAGE
TEST COUPLES 1-12
CHECK COUPLES 13-22

Location of thermocouple junctions in a cylinder containing a specimen of clay. An electric current of constant strength is sent through the heating element until a steady state obtains.

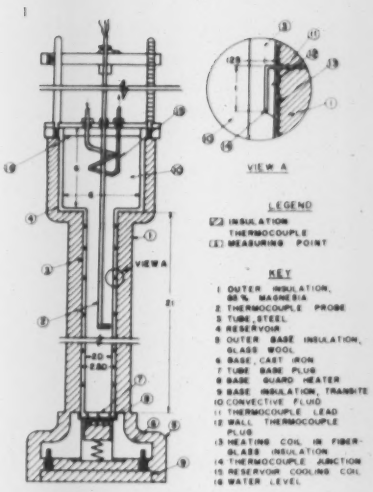
Heat-Transfer and Flow-Friction Characteristics of Woven-Screen and Crossed-Rod Matrixes, by L. S. Tong, Westinghouse Electric Corp., Pittsburgh, Pa., and A. L. London, Mem. ASME, Stanford University, Stanford, Calif. 1956 ASME Annual Meeting paper No. **56—A-124** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1957).

FINE-STRUCTURE matrixes of the woven-screen or crossed-rod type are here discussed and analyzed. Their many advantages indicate possible use as fuel element geometries for gas-cooled, diphenyl-cooled, and nonboiling water reactors, as well as for more commonplace applications such as packed absorption and extraction columns, and the "periodic flow" regenerative heat exchanger for automotive gas-turbine application.

Basic heat-transfer and flow-friction design data for these geometries are presented graphically, in nondimensional form, for a range of Reynolds numbers from 5 to 100,000, and matrix porosities from 0.60 to 0.83. Algebraic equations which adequately represent these data are also given, and these may be used for interpolation, and, at least tentatively, for a limited extrapolation beyond the range of porosities covered in this program.

Experimental Studies of Free-Convection Heat Transfer in a Vertical Tube with Uniform Wall Heat Flux, by J. P. Hartnett, Assoc. Mem. ASME, and W. E. Welsh, University of Minnesota, Minneapolis, Minn. 1956 ASME Annual Meeting paper No. **56—A-113** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1957).

THIS is a report on an experimental program to determine the free-convection heat-transfer performance of a fluid in a vertical tube closed at the bottom. The research was suggested by several current applications, such as the cooling of turbine blades by circulation of a coolant in hollow passages interior to the blades. The cooling of nuclear-reactor passages may depend on free-convection heat transfer in the event of pumping failure. The unique features of such a configuration are that some type of counterflow exists within the tube, the fluid forming its own patterns for each flow direction, with the tube wall



Apparatus for the study of the heat-transfer performance of a fluid in a vertical tube closed at the bottom

exerting a confining effect on the flow.

This study does not completely simulate the turbine blade-cooling application, for it imposes uniform gravitational force at all axial positions, while in the turbine blade this force will vary with the radius.

Following a description of the tests and plotting of results, comparisons are made with many previous studies of similar heat flow. The conclusion is drawn that for fluids other than liquid metals, the average heat-transfer performance in a vertical tube closed at the bottom is equivalent to the cases of constant wall temperature and constant heat-flux boundary conditions.

Skewed Boundary-Layer Flow Near the End Walls of a Compressor Cascade, by R. W. Moore, Jr., Arthur D. Little, Inc., Cambridge, Mass., and D. L. Richardson, United Aircraft Corp., East Hartford, Conn. 1956 ASME Annual Meeting paper No. **56—A-131** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1957).

TURBULENT end-wall boundary layers with considerable skewness are caused by the relative motion of adjacent blade rows in an axial compressor, and the behavior of such boundary layers can strongly influence compressor performance. This paper is a report on experiments in which flow conditions, similar to those near the hub in the blade passages of an axial-compressor rotor, were produced in a stationary cascade of blades. The effects on the inlet flow of a moving end wall ahead of the blade row were

simulated by use of a splitter plate and a suction slot.

Results of extensive measurements of boundary-layer flow between the blades are presented. An estimate based on the data of the values of terms in the momentum integral equation in the free-stream direction shows the importance of the cross flow in determining boundary-layer growth. A qualitative description of end-wall flow is presented.

Metal Processing

On the Basic Mechanics of the Grinding Process, by W. R. Backer, Assoc. Mem. ASME, and M. E. Merchant, Mem. ASME, The Cincinnati Milling Machine Company, Cincinnati, Ohio. 1956 ASME Annual Meeting paper No. **56—A-43** (in type; to be published in Trans. ASME; available to Oct. 1, 1957).

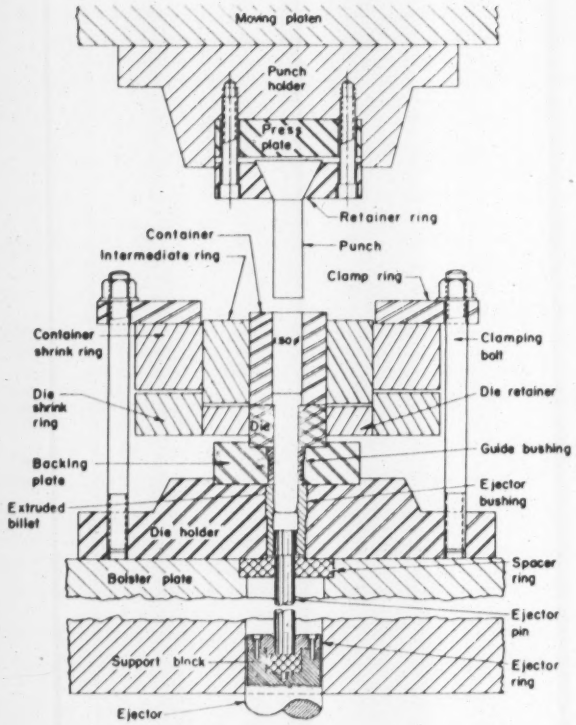
NEW geometrical concepts of grinding are presented and combined with metal-cutting principles to predict grinding forces. Experimental evidence is used to show the dependence of grinding mechanics on three fundamental variables, the length and cross-sectional area of the undeformed chip, and the cutting speed. These same three variables are shown to have no effect on grinding ratio, the wheel wear varying only with the metal removed for the test conditions employed. Variations in grinding ratio from run to run are found to have a distribution in line with tool-life tests for other machining operations.

An Experimental Study on Chatter Vibrations in Grinding Operations, by S. Doi, Nagoya University, Chikusa-Ku, Nagoya, Japan. 1956 ASME Annual Meeting paper No. **56—A-6** (in type; to be published in Trans. ASME; available to Oct. 1, 1957).

DURING the grinding process there frequently occurs a lateral vibration of the rotating wheel. In this experiment that vibration was magnified under the microscope and measured on a rotating film. Many modes of vibration were ascertained experimentally, produced by irregularity of the journal of the main spindle; peripheral irregularity of the grinding wheel; a flexible main spindle; clearance in the main bearing; the driving-belt seam and the flapping vibration of the driving belt on the main spindle; a flexible workpiece; the deflection of a grinding machine, and so on. The causes and the characters of these vibrations and some preventative methods were investigated. It has been found that a plain bearing used as the main bearing of a grinder is superior to a ball bearing in so far as prevention of vibration of the wheel is concerned.

Cold Extrusion of Unalloyed Titanium, by A. M. Sabroff, O. J. Huber, and P. D. Frost, Light Metals Division, Battelle Memorial Institute, Columbus, Ohio. 1956 ASME Annual Meeting paper No. **56—A-88** (in type; to be published in Trans. ASME; available to Oct. 1, 1957).

THE first known successful cold extrusion of titanium was accomplished at Battelle Memorial Institute on a project for Wright Air Development Center. Working with commercially pure grades of titanium having 45,000 and 70,000-psi yield strengths, and employing a Battelle-developed fluoride-phosphate coating for titanium, billets $1^1/_2$ in. diam were forward extruded to bars 1.16, 1.06, and 0.95 in. diam. These correspond to reductions of 40, 50, and 60 per cent. The fluoride-phosphate coating, in combination with a conventional oil-graphite-molybdenum disulphide lubricant, prevented seizing and galling and produced a smooth surface finish. The extruded bars exhibited as high as a 60 per cent increase in strength, yet adequate ductility (10 per cent in 1 in. minimum) was maintained.



A schematic drawing of the complete tool assembly used for conducting cold-extrusion experiments of unalloyed titanium at Battelle Memorial Institute. The tools consist of a punch, container, interchangeable dies, and ejector.

Materials Handling

Materials Handling of Bulk Materials in the Meat-Packing Industry, by P. Speer, Armour & Company, Chicago, Ill. 1956 ASME Annual Meeting paper No. **56—A-193** (multilithographed; available to Oct. 1, 1957).

BY MODERNIZING the materials-handling equipment for low-value, nonfood by-products in several of its larger plants, Armour & Company succeeded in reducing the cost of processing by a substantial margin. In the new installations, interesting applications were made of many types of mechanical conveying equipment resulting in improvement in quality as

well as cost reduction. A description of the equipment, in operation for nearly two years, and the reasons for its selection are given.

Fork Truck Stability—A Study in Moments, by R. W. Puder, Assoc. Mem. ASME, W. H. Bogar, Mem. ASME, R. D. Jay, E. I. du Pont de Nemours & Company, Inc., Wilmington, Del. 1956 ASME Annual Meeting paper No. **56—A-114** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1957).

THE subject of the stability of fork-lift trucks is becoming increasingly important. In the early days of fork-lift trucks the methods used for calculating truck stability were entirely adequate, but now the problem of stability is in need of review. The authors first give a brief history of fork-lift truck development showing its evolution from a truck where loads were light and lifting heights not great, to a current extreme application of a 36-ft lift unit which routinely places 2000-lb loads on the roof of a three-story building. In fork-lift truck operation, safety is most essential. Instability of a truck might result in injury to the operator, damage to the goods, and damage to the environment.

Previous practice has been to calculate fork-truck capacity ratings by considering the load to be supported on a simple cantilever system. The authors present an analysis which considers the effect of dynamic loads and a nomograph for rapid determination of truck capacity.

Materials Handling in Product Finishing, by J. C. Somers, Mem. ASME, Industrial Products Engineering Company, Long Island City, N. Y. 1956 ASME Annual Meeting paper No. **56—A-150** (multilithographed; available to Oct. 1, 1957).

THIS paper describes a few of the engineering problems involved in the handling of materials which require a finish coat of paint or lacquer. Many operations, besides the actual painting, are involved, such as degreasing, washing, bonderizing, and so on. Because of the nature of the problem, the materials-handling engineer is faced with the project of layout, involving the handling of equipment and the choice of new equipment.

Examples of three finishing systems are given. Equipment notes are made with specific reference to spray booths, paint dipping, baking ovens, washers, degreasers, drying and blow equipment, and carriers. The data required by the materials engineer for proper planning and design are listed.

Simplicity and beauty of functional design for church and auditorium using V-type glued laminated arches. First Presbyterian Church, Arkadelphia, Ark. AIA Merit Award 1955. Ginocchio, Cromwell, Associates, Architects.

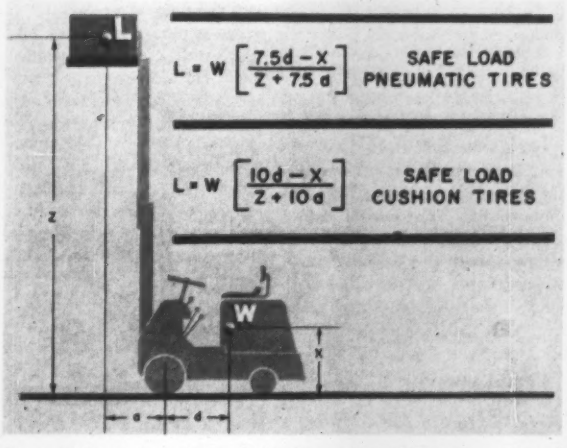
Wood Industries

Recent Developments in Engineered Timber Construction, by J. C. Van Dyke, Unit Structures, Inc., Peshtigo, Wis. 1956 ASME Annual Meeting paper No. **56—A-136** (multilithographed; available to Oct. 1, 1957).

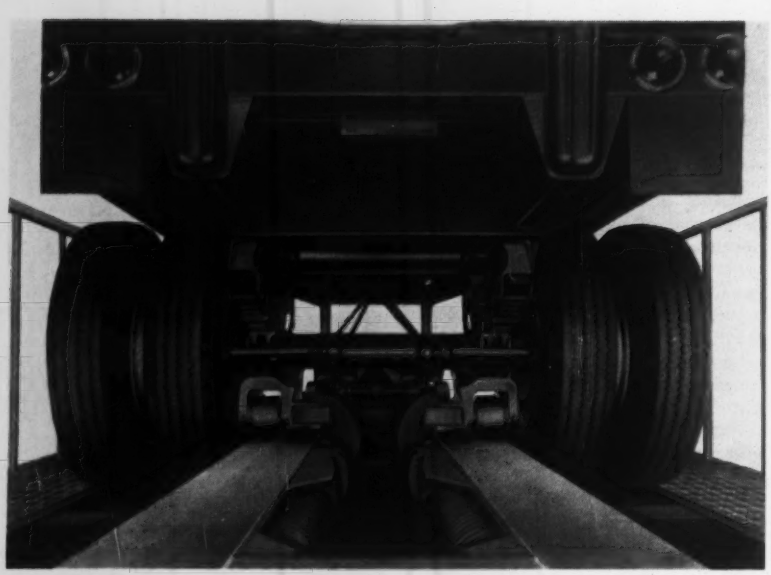
ENGINEERED timber construction implies the application of engineering principles and techniques to the design, fabrication, and use of timber as a construction material or as a component of a structural system. A brief background or history of wood is given. The present age has recently become aware of the remarkable and versatile qualities of the material. Recent developments which have done much to foster the use of wood in this age are listed. Examples of some of the present uses of wood are also given.

The Design of Timber Roof Truss With Nail-Glued Connections, by B. M. Radcliffe, Place Enterprises, Inc., South Bend, Ind. 1956 ASME Annual Meeting paper No. **56—A-180** (multilithographed, available to Oct. 1, 1957).

LIGHT timber roof trusses, with nail-glued gusset plates, are highly indeterminant structures and therefore difficult to design theoretically. A model analysis of truss behavior under load, in which electric resistance strain gages are used, is presented. A method for determining experimentally the distribution of forces and bending moments throughout a model truss is given, with calculations for the test of a king-post truss. Model constants are derived and the method of designing full-size trusses from results of model tests is explained. Calculations for the design of a 32-ft-span king-post truss are used as examples of the procedure. The test results, from the standpoint of both strength and stiffness, of the full-size 32-ft-span truss are presented. Emphasis is given to the deflection behavior of the lower chord as well as the ultimate strength of the structure.



Formula for calculating safe loads on fork-lift truck. Use of the above formula gives the safe load for a particular fork truck at any selected lift height. No trial and error is involved.



Rear-axle attachments which guide the trailer on the car and supply the sockets for the car locks

Railroad Technology

The Effect of Improved Draft Gears and Spring-Dampened Trucks on Freight-Car Shocks, by H. W. Faus, Fellow ASME, Consultant, New York, N. Y. 1956 ASME Annual Meeting paper No. **56—A-80** (multilithographed; available to Oct. 1, 1957).

FACTS illustrating the effects of improved draft gears and spring-dampened trucks on freight-car shocks are presented. Freight-car shocks are of two kinds: Longitudinal end shocks, resulting from impacts between freight cars either during switching or from inequalities of acceleration or deceleration in trains; and vertical shocks, resulting from undampened truck spring action. It is impossible, however, to assess separately the damage caused by each. Examples, from the author's own experience, illustrating the effects of each of these types of shock along with the steps taken to reduce them are presented.

Improved draft gears and effective truck spring dampening devices are now available which will greatly reduce these shocks and damage resulting from shocks.

Trailers in Piggy-Back Operation From a Manufacturer's Point of View, by J. J. Black, Trailmobile Inc., Cincinnati, Ohio. 1956 ASME Annual Meeting paper No. **56—A-82** (multilithographed; available to Oct. 1, 1957).

THIS paper reviews present methods of attaching trailers to flat cars in piggy-back operations. In order to evaluate various techniques, the components of typical trailers and their applications during ordinary road operation are described. With this approach, a comparison of the forces normally existing in a trailer structure and those due to tie downs, and so on, can be more easily visualized.

Furnace Performance Factors

In-Service Washing of Ljungstrom Air Preheaters on Pulverized-Coal-Fired Steam Generators, by H. J. Hupfer, Mem. ASME, and A. H. Van Sickle, The Detroit Edison Company, St. Clair, Mich., and R. J. Stanley, The Detroit Edison Company, Detroit, Mich. 1956 ASME Annual Meeting paper No. **56—A-161** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1957).

IN-SERVICE washing is defined as washing an air preheater while both air and gas are passing through the air preheater. The St. Clair Power Plant of The Detroit Edison Company has experienced difficulty with air-preheater fouling caused by flue-dust deposits on the cold-end surface. Removal of these deposits by the conventional out-of-service washing technique has not been satisfactory.

This paper includes a discussion of the equipment and methods used and the results obtained from 11 in-service washings of air preheaters at the St. Clair Plant. The results show that in-service washing provides a means for increased unit availability and improved boiler economy.

Oil and Gas Power

Design and Development of a Two-Cycle Turbocharged Diesel Engine, by P. J. Louzecky, Assoc. Mem. ASME, General Motors Corporation, Cleveland, Ohio. 1956 ASME Annual Meeting paper No. **56—A-100** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1957).

THE development of a successful design of two-cycle diesel engines for turbocharging involves many difficult problems, such as integrating the turbocharger to the engine, developing an exhaust manifold that will result in a minimum loss of heat energy, and making the engine components sufficiently rugged to carry the increase in engine loads. A solution to these problems, obtained by intensive study and testing, is presented in this paper. Also described are the favorable results achieved, which are improved fuel consumption, increased engine horsepower, and decreased engine size per horsepower as compared with nonturbocharged two-cycle diesel engines.

Applied Mechanics

A New Method to Measure Prandtl Number and Thermal Conductivity of Fluids, by E. R. G. Eckert, Mem. ASME, and T. F. Irvine, Jr., University of Minnesota, Minneapolis, Minn. 1956 ASME Annual Meeting paper No. **56—A-32** (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1957).

A NEW method is described by which the Prandtl number and indirectly the thermal conductivity of fluids can be measured. The method is based on the fact that a well-established, unique relation exists between the Prandtl number and the recovery factor for laminar high-velocity boundary-layer flow. The test setup is described which has been devised for such measurements, and test results are presented for air at atmospheric pressure and temperatures between 60 and 350 F.

Beams of Uniform Strength Subjected to Uniformly Distributed Loading, by W. A. Gross, Bell Telephone Laboratories, Inc., Murray Hill, N. J., and J. P. Li, Ford Motor Company, Dearborn, Mich. 1956 ASME Annual Meeting paper No. **56—A-9** (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1957).

BEAMS with uniform strength subjected only to bending have the same maximum flexural stress at any cross section. The shapes, deflections, and weights are given for cantilever, simple, and fixed beams of uniform strength and appreciable weight

subjected to uniformly distributed loadings. Explicit solutions are given for beams having rectangular cross sections and constant height. Solutions in integral form are provided for rectangular beams of constant width. This method is also applicable to beams with constant ratio of height to width, as well as beams with circular cross sections. Examples illustrate the large material savings over uniform cross-section beams which may be achieved.

Two-Dimensional Inflow Conditions for a Supersonic Compressor With Curved Blades, by P. Levine, Assoc. Mem. ASME, Wright Air Development Center, Dayton, Ohio. 1956 ASME Annual Meeting paper No. **56—A-49** (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1957).

RESULTS are presented on an analytical study of the flow field existing upstream of a blade row, where the axial flow is subsonic and the relative flow is supersonic. The flow model used as a basis for the calculations assumes isentropic flow and considers the case where the suction surface is a circular arc in the entrance region. The results clearly show the unique dependence of the flow through a blade row upon the geometry of the entrance region. Using the results, the complete flow field in the entrance region and upstream of the blade row can be constructed easily.

A New Approach to the Theory of Thin, Slightly Cambered Profiles, by F. S. Weinig, Mem. ASME, General Electric Company, Cincinnati, Ohio. 1956 ASME Annual Meeting paper No. **56—A-33** (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1957).

IF REAL and imaginary parts of a function of a complex variable are interpreted as velocity potential and stream function, then real and imaginary parts of the kth derivatives are the $(k-1)$st derivatives of the velocity components in the direction of the real and negative imaginary axis. For slightly cambered profiles that deviate little from the real axis and have the shape of a polynomial of nth order, the imaginary part of the nth derivative of the complex potential is constant in first-order approximation. It is easy to establish such functions of the complex variable in the case of single as well as cascade profiles. Integration then yields the intended results. While there is no continuing need for such a method for single profiles, it is needed for cascades of profiles.

Two-Dimensional, Steady, Cavity Flow About Slender Bodies in Channels of Finite Breadth, by H. Cohen, Rensselaer Polytechnic Institute, Troy, N. Y., and R. Gilbert, Carnegie Institute of Technology, Pittsburgh, Pa. 1956 ASME Annual Meeting paper No. **56—A-29** (in type, to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1957).

THE steady, cavitating flow past slender symmetrical bodies placed in a solid-wall channel is studied by means of the linearized theory of Tulin. The free-boundary condition is linearized and boundary conditions are applied on the line of symmetry of the flow in analogy with thin-air-foil theory. A singular integral equation formulation of the boundary-value problem is obtained and can be solved to yield expressions for cavity length, maximum cavity width, and drag coefficient as functions of the cavitation number and the channel breadth. These expressions are given for an arbitrary body and evaluated for the case of a wedge.

A Theoretical Analysis of the Viscous Flow in a Narrowly Spaced Radial Diffuser, by H. W. Woolard, University of Buffalo, Buffalo, N. Y. 1956 ASME Annual Meeting paper No. **56—A-18** (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1957).

A THEORETICAL method for calculating the radial pressure distribution for laminar viscous flow in a narrowly spaced radial diffuser having arbitrarily shaped walls deviating only moderately from a plane surface is developed. The analysis as it stands is also directly applicable to turbulent flow in the initial inlet region of a diffuser. Additional work is necessary to obtain a complete turbulent-flow analysis. Pressure distributions calculated by the laminar-flow theory show reasonably good agreement with the limited experimental pressure distributions available at the time of the analysis. Fairly good agreement also is obtained for the performance of a disk-valve element.

Corrections for the Oscillating-Disk Viscometer, by J. Kestin and H. E. Wang, Brown University, Providence, R. I. 1956 ASME Annual Meeting paper No. **56—A-34** (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1957).

THE paper reviews existing theories of the oscillating-disk viscometer and demonstrates their inadequacy. Using the results obtained previously by Kestin and Persen together with an empirical assumption that the edge-correction factor is proportional to the ideal viscous torque pieced together from the infinite-disk and infinite-cylinder solutions, the authors are able to develop working formulas which, in addition to the edge effect, include the effect of wire damping and unequal separation. The effect of a stem is discussed separately and shown to be negligible. Some remarks are made about the decrement-period relationship. The assumptions are compared with experimental results which demonstrate that for a given suspension system the edge-correction factor C depends on the dimensionless ratio $x_0 = \delta/R$ ($\delta = \sqrt{[\nu/\omega_0]}$ is the average boundary-layer thickness and R is the external radius of the disk) in a unique way. This shows that the use of the authors' equations together with a suitable calibration procedure should lead to reliable values of viscosity.

The State Principle—Some General Aspects of the Relationships Among the Properties of Systems, by S. J. Kline, Mem. ASME, and F. O. Koenig, Stanford University, Stanford, Calif. 1956 ASME Annual Meeting paper No. **56—A-4** (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1957).

AN INDEPENDENT generalization, here called the "State Principle," is necessary for the development of thermodynamics. Previously, this principle has been either tacitly assumed, or at best stated incompletely. A discussion and explicit formulation of this principle are given. The Phase rule is deduced from the State Principle and certain related empirical information. In this derivation no reference whatsoever is made to the First Law or the Second Law of Thermodynamics. A new, simple, systematic means for counting the number of components in the phase rule, which has no known exceptions and which does not rely on either advanced thermodynamics or the First and Second Laws, is presented. Examples of its use are included.

Effect of Adverse Pressure Gradients on Turbulent Boundary Layers in Axisymmetric Conduits, by J. M. Robertson, Mem. ASME, University of Illinois, Urbana, Ill., and J. W. Holl, Pennsylvania State University, University Park, Ill. 1956 ASME Annual Meeting paper No. **56—A-25** (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1957).

THE development of the three-dimensional boundary layer in a diffuser with several discharge arrangements has been studied for air flow, in continuation of the work of Uram. The flow condi-

tions in a diffuser when followed by a straight pipe, an additional length of the diffuser, or a jet, are compared. Extension of the method of analysis developed by Ross for two-dimensional layers is presented. In some cases the use of three-dimensionally defined parameters leads to different results. Ross's unique outer-flow parameter is found to be no longer satisfactory. Other outer parameters are presented as possible substitutes.

Head Loss in Flow Through a Cyclone Dust Separator or Vortex Chamber, by H. E. Weber, Shell Development Company, Emeryville, Calif., and J. H. Keenan, Fellow ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1956 ASME Annual Meeting paper No. **56—A-8** (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1957).

AN ANALYSIS for predicting the head loss in flow through a cyclone dust separator is presented. The effect of wall friction is indicated by consideration of two cases—one for zero wall friction, the other for wall friction great enough to eliminate the angular momentum of the stream. Comparisons of the analysis are made with the experimental data obtained from a test cyclone in which the flow rate, the depth of the inlet area, the radius of the exhaust pipe, and the extension of the exhaust pipe into the cyclone were variable. In general, the agreement between the theoretical and experimental results is good. The regions of deviation between the two results are evaluated qualitatively with respect to the effects of wall friction on the head loss.

A Statistical Appraisal of the Prot Method for Determination of Fatigue Endurance Limit, by W. A. Hijab, American University of Beirut, Beirut, Lebanon. 1956 ASME Annual Meeting paper No. **56—A-50** (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1957).

A STATISTICAL analysis of the precision of the estimate of endurance limit as determined by the Prot method is carried out. This analysis shows that the Prot method cannot achieve a great saving in the number of specimens required, for its statistical efficiency is found to be even less than that of its other two competitors, the probit and staircase methods. This fact, coupled with serious objections to its assumptions, renders its usefulness highly questionable. A secondary result of the analysis is that the optimum efficiency of the Prot method is achieved when only two rates of increase of stress, as widely separated as possible, are used. A derivation of a general formula, of which the Prot method is a particular case and which makes explicit all assumptions necessary for the valid derivation of the Prot method, is also given.

Stresses and Displacements in an Elastic-Plastic Wedge, by P. M. Naghdi, Mem. ASME, University of Michigan, Ann Arbor, Mich. 1956 ASME Annual Meeting paper No. **56—A-20** (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1957).

AN ELASTIC, perfectly plastic wedge of an incompressible isotropic material in the state of plane strain is considered, where the stress-strain relations of Prandtl-Reuss are employed in the plastic domain. For a wedge (with an included angle β) subjected to a uniform normal pressure on one boundary, the complete solution is obtained which is valid in the range $0<\beta<\pi/2$; this latter limitation is due to the character of the initial yield which depends on the magnitude of β. Numerical results for stresses and displacements are given in one case ($\beta = \pi/4$) for various positions of the elastic-plastic boundary.

Yield Loads of Slabs With Reinforced Cutouts, by P. G. Hodge, Jr., Mem. ASME, and N. Perrone, Polytechnic Institute of Brooklyn, Brooklyn, N. Y. 1956 ASME Annual Meeting paper No. **56—A-7** (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1957).

THIS paper is concerned with the determination of the maximum serviceable load for uniform slabs with various shapes of reinforced cutouts. A method of computing upper and lower bounds on the carrying capacity of a plane slab with a reinforced cutout is presented. The slab is subjected to a uniaxial load which is either uniform or applied by means of a perfectly rigid clamp. The results are applied to several examples and are found to agree quite well with experimental values.

Collapse Strength of Redundant Beams After Lateral Buckling, E. F. Masur, University of Michigan, Ann Arbor, Mich., and K. P. Milbradt, Illinois Institute of Technology, Chicago, Ill. 1956 ASME Annual Meeting paper No. **56—A-51** (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1957).

ACCORDING to classical linear theory, slender beams buckle laterally under vertical loads which remain constant as the buckling amplitude increases. Unless prior yielding takes place, the loads corresponding to neutral equilibrium represent therefore the collapse strength of the beam. However, the inclusion of nonlinear terms in the strain-displacement relations modifies the predicted postbuckling behavior of redundant beams. If continued elasticity is postulated, increasing amplitudes are associated with increasing load magnitudes, which generally approach limiting values. These "ultimate loads" may be estimated by means of two principles establishing lower and upper bounds. Tests performed on a single-span beam of varying degrees of end restraint show good agreement with the proposed theory.

Forced Vibration of a Body on Elastic Stratum, by G. B. Warburton, University of Edinburgh, Edinburgh, Scotland. 1956 ASME Annual Meeting paper No. **56—A-35** (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1957).

THE paper considers the forced vibration of a body with a circular base resting on a homogeneous elastic stratum of infinite surface area and constant depth. The body is subjected to a vertical disturbing force along the axis of symmetry. After evaluating an integral given by Arnold, Bycroft, and Warburton, curves are given showing the dependence of the resonant frequency on three parameters. Good agreement is obtained between theoretical values of the resonant frequency and experimental values taken from the previous paper.

Buckling of Initially Imperfect Cylindrical Shells Subject to Torsion, by W. A. Nash, Mem. ASME, University of Florida, Gainesville, Fla. 1956 ASME Annual Meeting paper No. **56—A-36** (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1957).

AN ANALYTICAL solution based upon large-deflection shell theory is presented for the problem of the elastic instability of a thin cylindrical shell subject to torsion. The fundamental equations used are those presented by Donnell in 1934, and these equations together with the condition of stationary potential energy are employed to determine all arbitrary deflection parameters. Boundary conditions corresponding to clamped-end shells and also to shells having simply supported ends are considered. Load-deformation relations for various magnitudes of initial imperfection of the shell are determined for both boundary conditions. Lastly, values are presented for an imperfection factor based upon existing

experimental evidence for clamped-end shells. The investigation described here is a continuation of work done earlier by Loo.

General Instability of a Ring-Stiffened, Circular Cylindrical Shell Under Hydrostatic Pressure, by S. R. Bodner, Avco Manufacturing Corporation, Stratford, Conn. 1956 ASME Annual Meeting paper No. **56—A-30** (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1957).

THE general instability load of a ring-stiffened, circular cylindrical shell under hydrostatic pressure is determined by analyzing an equivalent orthotropic shell. A set of differential equations for the stability of an orthotropic shell is derived and solved for the case of a shell with simple end supports. The solution is presented in terms of parameters of the ring-stiffened, isotropic shell, and a relatively simple expression for the general instability load is obtained. Some numerical examples and graphs of results are presented. In addition, an energy-method solution to the problem is outlined, and the energy and displacement functions that could be used in carrying out a Rayleigh-Ritz approximation are indicated.

Structural Damping of a Simple Built-Up Beam with Riveted Joints in Bending, by T. H. H. Pian, Massachusetts Institute of Technology, Cambridge, Mass. 1956 ASME Annual Meeting paper No. **56—A-2** (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1957).

A THEORETICAL study is made of the structural damping in the bending of a simple built-up beam with thin reinforcing spar caps in which the rivets or screws prevent the sliding motion between the cap and the beam. An analytical expression of the energy loss per cycle of static loading is derived in terms of amplitude of load, stiffness of rivets, and tightness of joint. Experimental measurements on a test beam provide a qualitative verification of the theory.

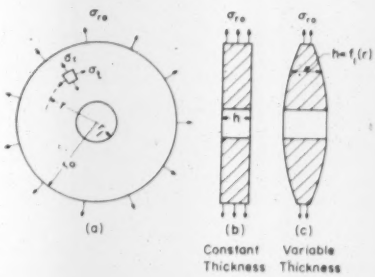
A Mixed Boundary-Value Problem of Elasticity with Parabolic Boundary, by Gunadhar Paria, Indian Institute of Technology, Kharagpur, India. 1956 ASME Annual Meeting paper No. **56—A-24** (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1957).

THE problem of finding the stress distribution in a two-dimensional elastic body with parabolic boundary, subject to mixed boundary conditions, has been reduced to the solution of the nonhomogeneous Hilbert problem following the method of complex variable. The result has been compared with that for a straight boundary.

Machine Design

Stress Distributions in Rotating Disks Subjected to Creep Including Effects of Variable Thickness and Temperature, by A. M. Wahl, Fellow ASME, Westinghouse Research Laboratories, Pittsburgh, Pa. 1956 ASME Annual Meeting paper No. **56—A-162** (multilithographed; to be published in *Journal of Applied Mechanics;* available to Oct. 1, 1957).

IN A previous paper some formulas were given for calculating steady-state stress distributions in rotating disks having central holes and subjected to creep at elevated temperature, based on the Tresca (maximum shear) criterion and the associated flow rule. It is the primary object of this paper to calculate some stress distributions for cases of steady-state creep in rotating disks having central holes, with various ratios, r_o/r_i, of outer to inner diameter and with various values of the exponent n in the power function stress-creep rate relations assumed. In addition, the effects of variations in thickness and in temperature are studied. A disk of variable thickness and one with variable temperature are also analyzed using the same methods. It is hoped that the calculated curves may be helpful to designers in supplementing engineering judgment by giving an indication of the stress distribution and creep deformation in steam and gas-turbine disks subjected to long period loading at elevated temperatures.



A rotating disk of outer radius, r_o, and inner radius, r_i, is subject to radial stress, σ_{ro}, acting at the outer edge. At any radius, r, the radial and tangential principal stresses are σ_r and σ_t, respectively, the disk being assumed thin enough so that stresses in the axial direction are zero.

Designing Jet Engines With a Medium-Size Digital Computer, by F. R. Heath, Assoc. Mem. ASME, Westinghouse Electric Corporation, Kansas City, Mo. 1956 ASME Annual Meeting paper No. **56—A-143** (multilithographed; available to Oct. 1, 1957).

WHEN the jet engine first made its appearance it was considered merely another component which could be designed and developed more or less independently of the remaining components comprising the aircraft. As aircraft systems became more critical and their performance demands mounted, it became apparent that each component of the system had to be developed with the whole system in mind. There are large numbers of calculations to be made in the following four major design and test areas of jet-engine development: preliminary design; performance calculation; component design, matching, and modification; and testing.

Several years ago the Aviation Gas Turbine Division of the Westinghouse Electric Corporation purchased a medium-size digital computer to mechanize the many calculations incident to the design and development of jet engines. This paper describes several characteristic types of calculations that have been programmed.

Graphical Versus Computer Techniques—For Mechanism Analysis, by L. F. Welanetz, Applied Physics Laboratory, The Johns Hopkins University, Silver Spring, Md. 1956 ASME Annual Meeting paper No. **56—A-48** (multilithographed; available to Oct. 1, 1957).

KINEMATIC analyses of a spring-driven shutter linkage mechanism were made, both by the conventional graphical procedure and by the use of an automatic digital computing machine. A description is given of the general method of solution which involves the use of the principle of work and kinetic energy. A comparison is made of the two procedures with regard to accuracy and time required. Results of the calculations are shown in graphical form.

Fuels

Evaluating Coal by Utilization Cost, by W. H. Attwill, Mem. ASME, C. E. Day, Jr., Mem. ASME, E. I. du Pont de Nemours & Company, Inc., Wilmington, Del., and A. J. Johnson, Mem. ASME, Fuels and Combustion, Lansdowne, Pa. 1956 ASME Annual Meeting paper No. **56—A-211** (multilithographed; available to Oct. 1, 1957).

THE basic objective of a well-designed fuels-engineering program is to set up

procedures by which the plants served can be supplied continuously with satisfactory coals to produce power at minimum cost. The authors demonstrate how such a program has been applied, and the savings achieved, by the du Pont Company.

Through meetings with plant engineers and the company consultants, coal specifications were first drawn up. All phases of requisite coal quality and analyses are reviewed thoroughly with full consideration given to actual plant experience. When suitable coals have been selected, tentatively based on specifications developed, then their relative economic position must be compared. The measure used for this comparison is "utilization cost" which includes all costs of handling and preparing coals to the point of actual use; that is, the cost to the plant at the burners with allowance for any additional losses due to the specific characteristics of the coals, such as moisture or size consist. While many factors contribute to substantial savings, chief among them is the principle of "utilization cost."

Aviation

Airfreight Sales Development, by T. J. Harris, American Airlines, Inc., New York, N. Y. 1956 ASME Annual Meeting paper No. **56—A-173** (multilithographed; available to Oct. 1, 1957).

While it is necessary to design all-cargo aircraft, efficient terminal buildings and facilities, and to develop materials-handling techniques of a high order, it is also necessary to accompany these developments with similar developments in sales.

The author points out several economies that are affected by air transportation. The security provided by air transportation produces savings from lower packing costs and reduced tare weights. The methodology of airfreight produces savings in administrative and traffic management expenses. Another area in which airfreight provides economies is through its effect upon inventories and sales.

Measurement and Integration of Acceleration in Inertial Navigation, by J. M. Slater, North American Aviation, Downey, Calif. 1956 ASME Annual Meeting paper No. **56—A-160** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1957).

Inertial navigation is a relatively new art which has evolved in parallel with the development of high-performance supersonic aircraft and missiles. It depends upon sensing and integrating changes of vehicle motion to compute velocity, the first time integral of acceleration, and distance, the second. Measurement and integration of acceleration in inertial navigation are associated with instrumentation problems of a character different from those in other fields of technology. This paper outlines the principles of such measurement, and some typical approaches to instrumentation. The variety of acceleration-sensing devices described implies that no single solution has been found to fit all inertial navigation and guidance needs.

Materials Handling—Equipment and Techniques for Loading and Unloading All-Cargo Aircraft, by C. W. Meldram, Mem. ASME, The Charles W. Meldram Company, New York, N. Y. 1956 ASME Annual Meeting paper No. **56—A-197** (multilithographed; available to Oct. 1, 1957).

Speed, economy, and security are three essential elements in efficient ground handling and terminal operations. Reduction of the number of individual handlings of each package is a factor which will maximize each of these. Various methods which can be developed to reduce rehandling are discussed. The palletized-load method of handling is noted and suggestions to improve on this basic method are made.

Among these are the greater use of conveyers, and the use of stackable boxes to replace pallets. This method is seen as one of the steps in the eventual development of a full preloaded-unit load system involving expendable or re-usable shipping containers.

Experience With Water-Alcohol Injection on the J47 Engine, by M. K. Wolfson, General Electric Company, Cincinnati, Ohio. 1956 ASME Annual Meeting paper No. **56—A-152** (multilithographed; available to Oct. 1, 1957).

One very important advantage of the jet-engine cycle for aircraft applications is that it lends itself readily to thrust augmentation. There are two basic methods of thrust augmentation generally used for jet engines today. These are reheat augmentation, and water or water-alcohol injection. This paper concerns itself primarily with the development of the water-alcohol injection system on the J47 engine for the B47 airplane.

The basic requirement for augmenting the thrust of the J47 engines was to reduce the take-off roll of the airplane under high gross-weight take-off conditions, in order that high-gross-load take-offs could be accomplished on existing runways.

In considering water-alcohol augmentation, both compressor-inlet injection and combustion-chamber inlet injection were studied. Experimental tests showed that water-alcohol injection in the combustion chambers of J47-GE-13 engines holds the maximum potential for application on the B47 airplane.

The major advantages of the water-alcohol injection system for thrust augmentation include simplicity, reliability, maximum thrust prior to take-off roll, controllable augmentation, and economy. The one major disadvantage to using water-alcohol injection for augmentation is the logistics problem of supplying special tankage and equipment for a different fluid to be injected into the engine.

Air-Cargo-Terminal Design and Location, by J. R. Wiley, New York Port of Authority, New York, N. Y. 1956 ASME Annual Meeting paper No. **56—A-174** (multilithographed, available to Oct. 1, 1957).

The Port of New York Authority, as an airport operator, is most interested in the phase of the operations problem which deals with the design and location of air-cargo-terminal facilities. The author explains current thinking on this subject by reviewing the development of the 80-acre five-building cargo-terminal area which has been constructed recently at New York International Airport at a cost of $5,500,000. This paper describes the facilities and outlines some of the major considerations involved in their design and location.

Petroleum

Current Flow of Air, Gas-Oil, and Water in a Horizontal Pipe, by D. P. Sobocinski, University of Kansas, Lawrence, Kans., and R. L. Huntington, University of Oklahoma, Norman, Okla. 1956 ASME Annual Meeting paper No. **56—A-60** (in type; to be published in Trans. ASME; available to Oct. 1, 1957).

There are several operations in the production of petroleum in which three-phase concurrent flow of fluids takes place. In some cases this type of flow necessarily must occur, such as the lifting and transportation of gas, crude oil, or condensate and water from the reservoir to the first separator in the field. In another operation, three-phase flow is encountered when glycol is injected into a pipeline at the well-head with oil and wet gas, in order to prevent freeze-ups from gas-hydrate formation. The design

of piping for vertical, horizontal, and inclined multiphase flow has been done largely by the expensive route of trial and error. Poettman, et al., have analyzed data on a number of wells flowing oil, gas, and water vertically. This laboratory study was undertaken in view of the current interest in the concurrent flow of oil and gas in field-gathering pipelines along with the injection of a third water phase such as glycol.

Apparent Frictional Forces of Clamping Elements as Used in the Oil Industry, by E. I. Moser, Schlumberger Well Surveying Corporation, and J. C. Wilhoit, Jr., Assoc. Mem. ASME, Rice Institute, Houston, Texas. 1956 ASME Annual Meeting paper No. **56—A-31** (in type; to be published in Trans. ASME; available to Oct. 1, 1957).

THIS study endeavors to show a method whereby the clamping effect of such tools as drill-pipe slips, casing slips, and so forth, may be determined analytically. This subject is of interest in view of the fact that serrations on the faces of such clamping elements are often suspected of producing focal points of failure. It is shown that the individual teeth of the serration need not be of the conventional "saw-tooth" or "sharp-wedge" variety. The apparent frictional forces for penetrators having round tips were found to be worth considering for clamping elements.

The Application of Gas/Liquid Cyclones in Oil Refining, by J. R. J. Van Dongen, Royal Dutch/Shell Group, The Hague, Holland, and A. J. Ter Linden, Technische Hogeschool, Delft, Holland. 1956 ASME Annual Meeting paper No. **56—A-61** (in type; to be published in Trans. ASME; available to Oct. 1, 1957).

THE two-phase flow of liquids and vapors is encountered in many refinery processes. As most final products must be either in liquid form or in vapor form, the separation of the two phases is necessary at some stage in the process. Therefore the problem of separating liquids from vapors efficiently is of interest in oil-refinery practice.

ASME Transactions

THE March, 1957, issue of the Transactions of the ASME, which is the *Journal of Applied Mechanics* (available at $1 per copy to ASME members; $1.50 to nonmembers) contains the following:

Technical Papers

Velocity, Temperature, and Heat-Transfer Measurements, by D. S. Johnson. (56—A-19)

Viscous Flow in a Narrowly Spaced Radial Diffuser, by H. W. Woolard. (56—A-18)

Head Loss in Flow Through a Cyclone Dust Separator, by H. E. Weber and J. H. Keenan. (56—A-8)

Synthesis of Four-Bar Mechanisms by Method of Components, by J. Hirschhorn. (56—A-3)

A New Method to Measure Prandtl Number, by E. R. G. Eckert and T. F. Irvine, Jr. (56—A-32)

The State Principle, by S. J. Kline and F. O. Koenig. (56—A-4)

Structural Damping of a Simple Built-Up Beam, by T. H. H. Pian. (56—A-2)

Vibration Modes of Stators of Induction Motors, by E. Erdelyi and G. Horvay. (56—A-28)

Response of Beams and Plates to Random Loads, by A. C. Eringen. (56—A-5)

Dependence of Frequency Spectrum of Circular Disk on Poisson's Ratio, by R. L. Sharma. (56—A-10)

Forced Vibration of a Body on an Elastic Stratum, by G. B. Warburton. (56—A-35)

Longitudinal Impact of Semi-Infinite Circular Elastic Bar, by Richard Skalak. (56—A-37)

High-Speed Impact Phenomena, by J. H. Huth, J. S. Thompson, and M. E. Van Valkenburg. (56—A-15)

Experiments on Transient Two-Dimensional Stress and Strain Distributions, by A. J. Durelli and W. F. Riley. (56—A-11)

Theoretical Criterion for Fracture of Metals, by Takeo Yokobori. (56—A-21)

New Method for Construction of Hencky-Prandtl Nets, by E. G. Thomsen. (56—A-14)

Yield Loads of Slabs With Reinforced Cutouts, by P. G. Hodge, Jr., and Nicholas Perrone. (56—A-7)

Accuracy in Solution of Laplace's and Poisson's Equation, by H. G. Landau. (56—A-13)

Stresses and Displacements in an Elastic-Plastic Wedge, by P. M. Naghdi. (56—A-20)

Beams of Uniform Strength Subjected to Bending, by W. A. Gross and J. P. Li. (56—A-9)

Stress Distribution at Base of Stationary Crack, by M. L. Williams. (56—A-16)

Effect of Circular Hole on Pure Twist of Infinite Strip, by Osamu Tamate. (56—A-17)

Mixed Boundary-Value Problem of Elasticity, by Gunadhar Paria. (56—A-24)

Buckling of Initially Imperfect Cylindrical Shells, by W. A. Nash. (56—A-36)

Min-Max Solutions for Linear Mass-Spring System, by Eugene Sevin. (56—A-26)

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Comments on Papers

Including Letters From Readers on Miscellaneous Subjects

Solar Furnace

Comment by T. S. Laszlo[1]

THIS valuable paper[2] not only gives the brief history and operating principle of the high-temperature solar furnace, but contains as well the latest listing of these furnaces abroad and in this country.

The authors had to restrict themselves in discussing the theoretical principles involved. A few additional details, however, may be of interest to those who plan to study the use of solar furnaces in high-temperature work.

The loss of solar energy when passing through the earth's atmosphere is briefly mentioned. A very detailed discussion of this problem was given by Sigmund Fritz of the U. S. Weather Bureau. ("Transmission of Solar Energy Through the Earth's Clear and Cloudy Atmosphere," by S. Fritz, Transactions, Conference on Solar Energy, University of Arizona, Tucson, 1956.)

The lens-type solar furnace not only is more expensive to build than a corresponding mirror furnace, but has other serious disadvantages as well. The solar radiation passes through several lenses and is reflected by mirrors. Each optical element reduces the amount of transmitted energy and in the infrared region the loss in glass lenses is far greater than in good reflecting mirrors. Accordingly, the over-all efficiency and therefore the maximum obtainable temperature is lower in lens-type furnaces than in single paraboloid reflector furnaces of the same optical dimensions. Another disadvantage is that the necessarily thick glass lenses absorb so much of the infrared radiation that they may crack during operation.

In discussing tracking devices it is mentioned that auxiliary mirrors are easier to operate and are less expensive than the mechanism required to rotate the entire paraboloid. While this is so, it should be pointed out also, that auxiliary mirrors introduce additional energy losses due to dispersion and absorption. As a consequence the energy density is less uniform in the focal zone, the solar image is more diffuse, and the maximum obtainable temperature is reduced.

[1] Directo,r High-Temperature Laboratory, Fordham University, New York, N. Y.

[2] "The Solar Furnace. . .New Tool for High-Temperature Work," by Guy Benveniste and Nevin K. Hiester, MECHANICAL ENGINEERING, vol. 78, October, 1956, pp. 915–920.

Comment by F. Trombe[3]

THIS paper[2] is a good analysis of the problems of furnace utilization. It should be pointed out that one could obtain in a perfected furnace a temperature higher than 3500 K. It is even probable that one might obtain 4000 K, as it is possible that the effective flux may reach 2000 watts/cm sq. It is important to distinguish between temperatures obtained in equilibrium conditions when a body radiates all the energy it receives and working temperatures obtained during a given operation, when heat must be consumed by the operation itself. As the working temperature of a given operation approaches the temperature of equilibrium, the heat consumed in the operation decreases. The temperature of a given operation will therefore always be lower than the equilibrium temperature.

Furnace dimensions are important. Since we are dealing with heat exchangers, the dimensions of the furnace do not affect the maximum equilibrium temperature that can be reached. But as we use larger furnaces we can obtain a diminution of the difference between the working and equilibrium temperature. This is made possible by a relative reduction of the losses due to conductivity of the materials and the convection of gases.

Interest by The American Society of Mechanical Engineers in these problems is a good omen for the development of solar furnaces.

[3] Director, Solar Energy Laboratory, Paris, France.

Burning Fluid Coke

Comment by Dale C. Calhoun[4]

THE writer witnessed the burning of some 75 tons of fluid coke in the test operation which has been described by E. H. Smith.[5] The test was considered most successful; however, it was not considered of sufficient duration to give any information as to what the ultimate problems might be, if any, in the handling of the ash from the coke. One would, of course, recognize the fact that coke with an ash content as low as 0.12 per cent might possibly leave so little ash in the furnace that no problems would be presented regardless of the fusion or fluid temperature of the ash. Such a boiler as the one on which this test was conducted could not accumulate ash from fluid coke in excess of 600 lb per day. It would seem a good possibility that a greater part of this would or could be allowed to pass out through the stack, assuming that all fly ash collected is returned to the furnace, for the purpose of reducing carbon content without exceeding the allowable limits for fly-ash emission.

In the described test the boiler was normally operated on coal with liquid ash being removed intermittently from a molten hearth. Prior to the starting of the coke-burning test the molten ash was removed to the minimum level, however the molten bed which remained was considerable, possibly as much as six to ten in. in depth. It was of course not possible to determine the amount of fluid-coke ash deposited in the slag pool during the test or whether or not the furnace would require tapping even if the coke were burned continuously.

Another point to be considered would be the unburned coke particles which were deposited on the surface of the slag pool. Coke or coal so deposited burns very slowly and increases the difficulties encountered when tapping.

[4] Assistant superintendent, Carbide and Carbon Chemicals Company, South Charleston, W. Va. Mem. ASME.

Comment by R. M. Hardgrove[6]

FLUID coke has some unusual properties that require special treatment to utilize efficiently in boiler furnaces.

Production fluid coke runs about 5-6 per

[5] "Burning Fluid Coke," by Ollison Craig and E. H. Smith, MECHANICAL ENGINEERING, vol. 78, October, 1956, pp. 921–925.

[6] Research consultant, The Babcock & Wilcox Company, Alliance, Ohio. Fellow ASME.

cent volatile. As this is about the same as anthracite, we would expect it to behave like anthracite, and in many ways it does.

Our laboratory has tested fluid coke for ignition temperature and obtained a value of 1380 F which checks very well with the 1400 F obtained by the Ghosh and Orning method.

We have also done considerable work on relative reactivity of the fixed carbon of various fuels, and fluid coke lies between a 5 per cent vol anthracite and a 7 per cent vol anthracite.

Actual furnace tests show the unburned losses for fluid coke to be about the same as 5 per cent vol anthracite.

Several utilities have burned fluid coke in conventional pulverized-coal furnaces, using horizontal burners with 30–60 per cent supplemental coal or oil. It seems quite probable that much of the fluid coke produced will be burned in existing pulverized-coal units with supplemental fuel and no refeeding of unburned carbon will be necessary.

In their paper G. A. Watts and W. L. Sage[7] have referred to extensive tests burning fluid coke in cyclone furnaces. It can be burned either with supplemental fuel or alone with refeeding of the unburned fly ash. The cyclone is much more effective in consuming refed material than are pulverized-coal or spreader-stoker furnaces.

Recent tests on a large pilot pulverized-fuel furnace indicated that with pulverization up to 80 per cent 200 mesh, fluid coke can be fired with 600-F air, no supplemental fuel and unburned losses so low that no refeeding of unburned carbon is required.

The fluid coke is composed of uniformly sized spheres which give it a high degree of fluidity. In a pulverizer, slight adjustments are required to handle this unusual fluidity. Tests on the ball-bearing-type of pulverizer indicated a capacity equivalent to 36 Gd. coal.

As pointed out in this paper, the grindability test requires special treatment mainly because so much of the material is finer than 30 mesh that the usual 16–30 mesh sample is not representative.

Using the full set of screens, as described in the paper, helps some; but another alternate is to use the 16–60 mesh range as this includes a larger part of the original sample. Either single screen or multiple screen can be used.

Grindability determinations made several years ago on fluid coke were as high as 46 Gd. and later ones as low as 12, showing that the coke varies widely. However, samples received recently from three different sources were tested using the 16–60 mesh size method and gave 38—37 and 32 Gd. which seems to agree with the pulverizer-capacity tests which showed the fluid coke to be the equivalent of 36 Gd. coal.

[7] "Multifuel-Firing of Cyclone Furnaces," by G. A. Watts and W. L. Sage, MECHANICAL ENGINEERING, vol. 78, September, 1956, pp. 823–827.

Comments by F. H. Stracke[8]

THE brief review of the work done by the Riley Stoker Corporation in the field of combustion of fluid coke offers little opportunity for discussion. The only comments are by way of comparing the results of the reported test with other tests undertaken by the Esso Research and Engineering Company and witnessed by the writer.

Shortly after the inception of the fluid-coke process, Esso embarked on an extensive program of test work to determine the grindability and combustion characteristics of fluid coke. In laboratory-scale combustion tests conducted at the Battelle Memorial Institute, the burning characteristics of this material were determined using the same equipment as used by Sherman in his investigation of pulverized coal and char. The ignition times reported by the authors compare extremely well with that experienced at Battelle. Also, the test at Battelle indicated that combustion of this material would not require the large anthracite-type furnace, but could be burned in equipment designed for handling bituminous coal.

During April and May, 1955, full-scale combustion tests were conducted at the Essex Generating Station of the Public Service Electric and Gas Company. In these tests, approximately 500 tons of fluid coke were burned under the No. 1 Boiler. This boiler is a B&W 900,000 lb/hr radiant-type unit rated at 1500 psig and 1000 F at the superheater outlet. The boiler is equipped with air heaters, economizer, attemperator, and electrostatic precipitators. Pulverized fuel is supplied by three Foster Wheeler type D-5B ball mills with 350-hp motors, each feeding four B&W circular burners equipped for coal, oil, or gas firing.

Visual observation of the furnace indicated combustion of the coke stream was taking place immediately adjacent to the burner and that the combustion was fairly well complete before the gases entered the superheater. All the tests conducted were of four-hour duration and sufficient data were taken to determine the boiler efficiency, both by input-output measurements and heat-balance calculations.

In these tests, the flue dust to the precipitators average 0.135 lb/sec. Actual precipitator efficiency decreased with an increased loading from a high of 74 per cent with approximately 220 lb/hr entering the precipitators to a low of 30 per cent when approximately 560 lb of flue dust was entering. However, actual losses from the stack were calculated to be approximately 400 lb/hr when coke was supplying 45 per cent of the total heat to the boiler. It should be noted that the afore-mentioned figures also included the flue dust from the oil fired.

In the full-load tests, the boiler efficiencies ranged from a low of 87 per cent when coke supplied 17 per cent of the total heat to a high of 88 per cent when coke supplied 45 per cent of the total heat. This increase in efficiency is due mainly to the decrease in losses due to hydrogen in the fuel.

In all test work at the Essex Station, it was impossible to supply more than 45 per cent of the total heat from coke as the mill capacity was limiting.

The authors have devoted considerable space in explaining the method of determining the grindability of fluid coke. Due to the size and shape of the material, they found it was necessary to adapt a modified procedure to arrive at the Hardgrove grindability which they reported as 17.7. In our early test work on grinding fluid coke, we also came to the conclusion as to the ability to determine Hardgrove grindability by the standard procedure. In reporting grindability we have made use of a procedure developed by the Allis-Chalmers Manufacturing Company, whereby the power required to grind coke to any fineness can be determined from a rather simple test.

The majority of this work was undertaken by F. C. Bond and is reported in his paper "Third Theory of Comminution," (Trans. AIME, TB-3308B, *Mining Engineering*, May, 1952). In reporting the grindability of a material determined by this procedure, use is made of the "work index" method of comparison. In this method the work index is defined as the total work input in kwhr/ton required to reduce a given material from theoretically infinite particle size to 80 per cent passing 100 microns. Knowing the work index for a given material one has but to apply the proper equation and any feed-correction factors to determine the power input required. The only test work required to use this method is in determining the ball-mill grindability in net grams of undersized product per mill

[8] Group head, Esso Research and Engineering Company, Linden, N. J. Assoc. Mem. ASME.

revolution. Knowing this and by use of the proper formula, the work index can be determined. With the use of a second formula, the power required to grind this material to any given product size can be determined. From early work it was calculated that approximately 36 kwhr/ton would be required to grind coke to a fineness of 80 per cent through 200 mesh. During the full-scale tests at the Essex Station, actual power required to grind the coke to 85 per cent through 200 mesh was found to be 31 kwhr/ton.

Author's Closure

It is gratifying to find that most valuable contributions to this paper are included in the discussions by Mr. Calhoun, Mr. Hardgrove, and Mr. Stracke and the author wishes to express his appreciation for these discussions.

Dale Calhoun mentions that some small amount of coke was deposited on the surface of the hearth. This is not unsimilar to the manner in which large coal particles can be seen burning on flat-bottom, pulverized-coal furnaces. The radiant heat absorbed by these particles maintains combustion until they are burned out completely. At the temperatures existing in the hearth, the rate of reaction of a carbon particle with oxygen or carbon dioxide is rapid and gasification is therefore fast.

The Delaware Power & Light installation, which is specifically designed for coke firing, included other features designed for better coke burning. The mills are designed for finer coke grinding and provisions are made for returning the dust-collector catch to the pulverizers for regrinding. The lower terminal velocity of the finer particles will prevent their settling and the coke caught in the dust collector will be reduced in size before being refired.

In addition, the burners are provided with vertical adjustment of both primary and secondary air streams and it is to be expected that, as further experience with these adjustments is obtained and with the features listed above, burnout of the ash will be complete and the accumulation on the hearth will be similar to that experienced with an oil-fired unit.

The detailed information on coke grindability supplied by Mr. Hardgrove is particularly valuable but we wish to comment that we felt that because of the fineness of the raw coal sample, a sample passing through 16 and on 100 might be more representative than the 16–60 sample. The possibility exists that the smaller coke particles are harder than the larger ones.

In closing, the author wishes to acknowledge the assistance of his colleagues at Riley Stoker Corporation and particularly A. H. Rawdon, W. C. Rogers, J. Izbicki, and all others who assisted in these tests.

Eric H. Smith.[9]

Municipal Incinerators

Comment by Andrew H. Rose, Jr.[10]

The author of this paper,[11] in addition to evaluating those fundamental design factors affecting combustion efficiency, comprehensively defines the two major present-day design requirements which the engineer must resolve in the development of an effective incineration program.

The first requirement arises from change in fuel characteristics as a result of variations in heat content and bulk density. The second arises from the limitations imposed on contaminant stack discharges as a result of air-pollution-control legislation.

As indicated in the paper, those fundamental design factors relating to combustion efficiency must continually undergo refinement as technical advances relative to air-pollution control are made. In general, this trend has resulted in several major refinements or revisions to the basic combustion concepts presently held with regard to incineration. These revisions to the basic concepts are indicated by the author and were covered in more detail in the literature on incineration presented at the First International Congress on Air Pollution held in March, 1955, under the sponsorship of The American Society of Mechanical Engineers.[12] Basically, three revisions of significance must be considered. These revisions concern, first, grate loading to combustion-rate relationships; second, the combustion-air distribution; and third, ignition-chamber proportions.

The author has indicated that the presently accepted values for grate loading when considered from an air-pollution-control standpoint, have decreased from a norm of 70–90 lb per sq ft of grate area per hr to 50–60 lb per sq ft of grate area per hr depending upon the type of refuse to be incinerated. Present data indicate that this lower limit is still somewhat high and that a more appropriate burning rate would be from 40–50 lb per sq ft of grate area per hr. It should be noted that these grate-loading criteria are applicable only for the large municipal-type incineration equipment ranging from 50 tons per day and up.

For smaller capacity in capacity incinerators, it is of interest to note that grate loading expressed in lb per sq ft of grate area per hr decreases as a logarithmic function of capacity expressed in pounds-per-unit time.

The second revision, fundamental to incineration design when considered from the air-pollution standpoint, relates to combustion-air distribution. Of significance in this respect is the ratio of underfire air (combustion air distributed through the grates) to overfire air.

Present data indicate that optimum results from an air-pollution standpoint are obtained when from 85–90 per cent of the combustion-air requirements for the incineration process are supplied overfire. The ratio must, however, be based upon the stoichiometric air requirements for the particular chemical composition of the fuel concerned.

The third revision concerns ignition-chamber proportions. These have been considered by the author to be a function of ignition-chamber volume. It has been found that a refinement of this concept exists in the relationship of arch height to grate area. While this relationship does establish the ignition-chamber volume, it has been indicated to be more definitive in establishing combustion rate and contaminant discharge than the direct volumetric relationships.

It is believed that the effect of the relationship as to reduction of contaminant discharge, is demonstrated in the results of a recent incinerator installation in the Los Angeles area. The equipment is of basic multiple chamber-type design of 75 tons-per-day capacity employing a reflective arch and end charge. The grate loading during tests of this equipment was 45 lb of refuse per sq ft of grate area per hr, with 85 per cent of the combustion-air stoichiometric requirements supplied overfire. The discharge of contaminants to the atmosphere was 3.25 lb per ton of refuse incinerated, as contrasted with the 6 to 10 lb per ton of refuse as given in the paper.

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[9] Chief Engineer, Riley Stoker Corporation, Worcester, Mass. Mem. ASME.

[10] Chief, Engineering Research and Development Section, Community Air Pollution Program, U. S. Public Health Service, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Assoc. Mem. ASME.

[11] "Background of Design Criteria for Municipal Incinerators—The Designer's View," by Samuel A. Greeley, Mechanical Engineering, vol. 78, November, 1956, pp. 1024–1027.

[12] "Problems and Control of Air Pollution," edited by Frederick S. Mallette, Reinhold Publishing Corporation, New York, N. Y., 1955, pp. 95–107.

Comment by Warren A. Schneider[13]

THIS paper has been read with a great deal of interest and the following additional comments come to my mind.

Municipal combustible refuse is a highly variable fuel and in order to burn it successfully an incinerator must be designed to be capable of not only insuring adequate temperatures when Btu values of the fuel are low, but also of satisfactorily dissipating excess heat generated when Btu values are high. It is my opinion that much remains to be accomplished in the engineering design of municipal incinerators to provide such flexibility. As a consequence, when burning high Btu fuel, the actual operating capacity of the present-day plant is seriously reduced in order to prevent excessive deterioration of the equipment and reduced refractory life.

With the present emphasis being placed on the control of air pollution throughout the nation, it is extremely important to improve design to minimize the entrainment of particulate matter into the stream of combustion gas. The reduction of under-fire air to a practicable minimum, and the introduction of the fresh charges of the refuse fuel by some means other than through a top charging port, which causes the newly charged material to smother and interfere with the actively burning-fuel bed, would both merit consideration in seeking to attain such an objective.

Where performance is to be attained conforming to relatively strict air-pollution-control standards, it is the opinion of the writer that the percentage of the total cost allocated to items "(*c*) Furnaces, combustion chambers, flues and appurtenances" and "(*d*) Relatively simple fly-ash-removal facilities," should be higher than the 35.0 per cent and 7.0 per cent, respectively, shown in Mr. Greeley's "Table 9, Cost Breakdown."

As to fly-ash control, when once the particulate matter is entrained in the gas stream, it is the writer's opinion that, other things being reasonably equal, preference should be given to a "dry" system. Utilization of a "wet" system such as water sprays, bath, and the like, has certain secondary disadvantages such as: (1) excessive water use in single-pass systems, (2) operating problems from salt build-up in cooling-recirculating systems, (3) added nuisance in handling and disposing of waste waters from system, and (4) the increased and continuing water-vapor plume present at top of chimney, which in air-pollution-conscious communities is often taken by residents to be smoke, and as a result, creates an unfavorable public-relations situation.

A constant effort should be made to see that air-pollution-control laws and regulations are realistic with respect to operating problems of the municipal incinerator incurred because of the variable fuel. The appropriate authorities should recognize and approve of the utilization of suitable plant instrumentation to indicate and record performance, particularly the utilization of electronic smoke-indicating instruments, since direct visual observation of the smoke density existing at any time at the top of the chimney by an operator on the operating floor is virtually impossible in practically all incinerator plants.

The building and crane installation should be designed to readily and conveniently permit the unloading and handling of heavy equipment, parts, and supplies delivered to the plant.

I appreciate the opportunity of presenting the foregoing comments and hope that somewhere therein there may be a thought expressed which through the future action of your members, their associates, or others, may assist in the betterment of the science of municipal incineration.

[13] Director, Bureau of Sanitation, Department of Public Works, City of Los Angeles, Calif.

Comment by W. A. Xanten[14]

THE papers by Mr. Greeley[11] and Mr. Michaels[15] present two sides of the question on the design of incinerators. Since the papers complement each other they will be discussed together.

In general both authorities have a very similar viewpoint on all questions. The exception is that Mr. Greeley does not believe the consultant should be required to guarantee performance, and Mr. Michaels believes the designer should be obliged to guarantee the performance.

Superficially these seem normal attitudes in a designer and a user, but something more important is shown in both papers that underlies the insecurity of both parties. The fact is that very little dependable information is available about refuse and about the performance of incinerators. For many reasons incinerator design should be geared to meet local conditions, and too frequently insufficient advance study of the problem has led to unsatisfactory results. Refuse varies widely in its quantity and composition not only from city to city but from day to day in the same city. The problem is so complicated that even planning a rational method of analysing the composition of refuse is a very difficult matter. The wide variation in the physical makeup of loads on successive weeks from the same group of homes in Washington has been astonishing. To date no reasonable explanation has been found.

In trying to compare the costs and performance of various plants there are obstacles. Not only are there variations in fuels, but in methods of operation and in the manner in which costs are reported. Costs and quantities frequently reflect a desire to impress municipal authorities with performance. Extravagant claims are sometimes advanced to promote sales. Basically too few people are well informed on the subject and reliable information is difficult to secure.

The desire to "get something for nothing" is always cropping up in the refuse-disposal field. Design and operation become needlessly complicated by ill-advised schemes of this sort. Plants that attempt to salvage paper, metal, rags, and so forth have intolerable working conditions due to the nature of refuse. Except in rare instances the market for salvage material is unstable and speculative. The propriety of expending large amounts of public funds on a gamble of this sort is questionable. If the practice was lucrative, private firms would provide facilities and be eager to accept refuse for its salvage value. If this were the case, there would be no symposium on refuse incineration today.

In discussing air pollution both speakers strongly favor rating stack discharge on a basis of weight processed, rather than on the basis of volume of stack emission. This is sound. An incinerator is not a source of energy, but a processing plant and should be rated on that basis. Since the art of incineration is in a rudimentary stage, there is a very real danger that governing authorities by placing excessive restrictions on stack discharges or demanding unreasonable guarantees of performance may throttle the development of incineration and deny themselves the sanitary benefits and transportation economies of incineration in large population centers.

The phrase "0.4 grain per cubic foot calculated to 12 per cent carbon dioxide at standard conditions" has little significance to a plant operator or anyone else not familiar with air-pollution terminol-

[14] Superintendent, Division of Sanitation, Government of the District of Columbia, Engineer Department, Washington, D. C.

[15] "Design Criteria for Municipal Incinerators—The Customer's View," by Abraham Michaels, Chief of Refuse Disposal and Plant Operation, City of Philadelphia (Pa.). Paper No. 56—SA-60.

ogy. A plant operator is well aware of the amount of material processed each day.

At present a plant operator has no simple method of judging the amount of particulate matter emitted by the stack. Visual observation of the stack plume means little due to wide variation in color and sky background. Ringelmann Chart comparison has the same limitations. A white plume may indicate condensing water vapor or aerosols generated by smelting action at the grates caused by too much underfired air.

If it were found that a given furnace produced a fairly uniform amount of fly ash per ton of refuse burned, a rule of thumb could be established by which an operator could readily check the effectiveness of his air-pollution-control measures by comparing the amount of fly ash trapped with the amount of material burned. In other words the amount of fly ash produced in the furnace less the amount trapped equals the amount going up the stack. Although investigation to establish the relationship would require exhaustive tests on a number of plants, the results could greatly benefit incinerator design and operation. Air-pollution-control authorities would be spared much expensive stack testing if this method proved valid.

To amplify Mr. Greeley's comments on baffles in the Washington, D. C., incinerator: Since the plant has been in operation various arrangements of baffles have been tried. The most satisfactory to date consists of four baffles per expansion chamber spaced about 20 ft apart. One of the four is a diagonal wall $4^1/_4$ ft high; the others are 3 ft high. There is also a wall 5 ft high in the stack breeching to throttle the draft. This arrangement has trapped greater amounts of fly ash than any tried to date.

Both papers are an excellent contribution to the available material on this subject. The author also acknowledges the able assistance of J. S. Crocker, Staff Engineer of the Division of Sanitation in the preparation of these comments.

Author's Closure

I AM grateful to A. H. Rose, Jr., W. A. Schneider, and W. A. Xanten for their comprehensive and thoughtful discussion of my paper. They have in each case added to the study of a difficult problem. Mr. Rose suggests a grate loading as low as 45 lb of refuse per sq ft of grate area per hr. I do not think a definite rate can be stated. It should be kept as high as practicable with regard to the kind of refuse and the atmospheric environment. If too low rates of burning are required on account of air-pollution abatement, there will be occasions when disposal by incineration will be too expensive.

Much the same comment can be made to the statement by Mr. Schneider that the percentages in Table 9, Cost Breakdown, for Items (*c*) and (*d*) should be higher. Mr. Schneider's reference to the four secondary disadvantages of the wet system of fly-ash removal are well worth keeping in mind.

I do not follow the meaning of the second paragraph in the discussion by Mr. Xanten. I would say that the opposite of my understanding of this statement more nearly reflects my feeling. In the past, contractors have been required by "consultants" and municipal officials to guarantee performance and in some cases such guarantees have made up most of the specifications in the contract documents. The practice of my firm in the last five years has been to eliminate guarantees and thus to place the responsibility for the performance on the engineer and the municipality.

The author recommends that these discussions be carefully read in connection with the paper.

Samuel A. Greeley.[16]

Food Technology

Comment by H. B. Hass[17]

IN A recent paper[18] the statement is made, on page 811: "Taste tests at the University of Massachusetts and elsewhere show that canned fruits wherein the usual sucrose syrup has been replaced by saccharin or Sucaryl syrups of equivalent sweetness are as acceptable as the regular pack, and very much preferred to water-packed fruit." The reference cited in support of this statement, "Non-Caloric Sweeteners in Canned Fruits," *Journal of the American Dietetic Association*, vol. 29, 1954, pp. 770–773, however, does not bear out the statement.

The following is a tabulation of the actual results reported, which shows a strong preference for the sucrose pack over either Sucaryl or saccharin-packed fruit.

	Sucrose	Saccharin	Sucaryl
Blueberries	2	3	1
Raspberries—1950	1	?	?
Raspberries—1951	2(tie)	2	1
Cherries	1(tie)	1	2
Pears	1	2(tie)	2
Peaches	1(tie)	1	2
Rhubarb	1	2(tie)	2
Average	1.28	1.83	1.66

The basic science behind this preference is clear from a paper by Davis, Herstein, Kononenko, and myself, presented September 17 at the Atlantic City (N. J.) Meeting of the American Chemical Society. Sucrose increases the fugacity of the fruity aromas, which must reach the nose in order to register a sensation of flavor. Saccharin and Sucaryl have only a negligible effect because they are used in such low concentrations.

The implication that people are somehow helped to prevent, or control, obesity by the use of artificial sweeteners is completely contrary to fact. Work at Harvard University published in the *Journal of the American Dietetic Association*, vol. 32, 1956, pp. 327–329, shows that "the use of noncaloric sweeteners and artificially sweetened foods, when considered on a group basis, appears to be of no particular value in a reducing program." Of course, while calorie consciousness is necessary to control weight, the myth that calories from sugar are any more fattening than those from any other food is an erroneous one.

Author's Closure

Dr. Hass in his zeal to defend sucrose, in effect asks that we change the conclusions of Dr. Fellers and co-workers. A re-reading of the paper to which Dr. Hass refers indicates that we very fairly summarized the views presented as to the relative acceptability of water-packed fruit and fruit sweetened with sucrose, or an artificial sweetener. Dr. Fellers has assured us that this is correct.

The differences found by Dr. Fellers, et al., in preferences between different sweeteners, including sucrose, were minor and varied from fruit to fruit, with some first choices for each sweetener. The "average" figures calculated by Dr. Hass suggest a ranking of these sweeteners not supported by a common sense study of the paper. The averaging of rhubarb, cherries, and peaches appears inadmissible to us. We suggest that those interested refer to the original publication.

A. G. Olsen.[19]
D. A. Mills.[20]

[16] Partner, Greeley and Hansen, Engineers, Chicago, Ill.

[17] President, Sugar Research Foundation, Inc., New York, N. Y.

[18] "Recent Advances in Food Technology," by A. G. Olsen and D. A. Mills, MECHANICAL ENGINEERING, vol. 78, September, 1956, pp. 802–814.

[19] Technical Director, Research Planning, Central Laboratories, General Foods Corporation, Hoboken, N. J.

[20] Information Services Supervisor, Central Laboratories, General Foods Corporation, Hoboken, N. J.

Machine Tools

Comment by Baxter H. Webb[21]

THE subject[22] is interesting and the author must be a thoughful and patient man. However, either the paper was condensed unduly, or Mr. Ottesen could profit from reading Eugene Grant's "Engineering Economy" or Philip Scheuble's "Practical Equipment Replacement Economics" (Paper No. 56—MGT-2). I haven't been able to visualize many uses for the equations or nomograms, unless it is the pricing of parts using the same tooling. Since this is an area of widespread misunderstanding and often of serious error, I would like to briefly describe the process of determining whether a tool should be replaced.

The first question to be answered is the outlook for the company and for the industry. Does it appear that product change will obsolete tools in a short time? Or is demand shifting away from the company? What volume may reasonably be expected?

The second has to do with the process being used. Is the process the best for the company and for the part? In many companies, the competition between the punch press and the die-casting machine, between castings and forgings, between aluminum and steel, illustrates the need.

The third is to list the alternatives. (This is not wholly separate from the second.) Usually the alternatives are as follows:

1 Continue as at present

2 Modify utilization of present equipment

Often better scheduling will greatly increase production of present equipment

Improved transportation—conveyers may affect costs more than production machines

Modification of equipment characteristics

3 Rent other equipment

4 Buy other equipment

5 Buy the part from another supplier.

How do we make these comparisons?

Here is where many people go astray. The author appears to be one of them, when he says, "What is the initial cost of the current tools?" It makes no difference what that initial cost was, or what the book value of the tool is. The cost of what you have is a "sunk" cost, and no decision that you make today can alter the fact that you have paid for it or will have to pay for it. The exception is when you are renting, and in this case, past rental payments are not pertinent.

The costs associated with the current tools that are important are salvage or removal costs, expected maintenance, operating, and insurance costs.

There is room for difference of opinion on the required payoff time. In our operations, although we expect to be in business a long time, I do not consider payoff periods longer than a year for individual items, or 15 years for land and buildings. Hopefully, developments in equipment will continue at an accelerated pace, and the engineer who expected his new equipment to be useful for five years will have some explaining to do or a bankrupt or seriously weakened company if it is obsolete at the end of a year. Tabulating and computing equipment manufacturers will rent equipment; this forms a good hedge against obsolescence, and avoids tying up working capital. We are using this approach wherever we can.

There are two most useful approaches to comparison:

1 Comparison by rate of return on additional investment

2 Comparison by time of payoff of additional investment.

Personally, I like the second, perhaps because we do not have a profit to show.

As a check list of items to be compared to determine which alternative to use, the author's list can be helpful, and his nomogram of some use, provided we do not make the mistake of assuming that different alternatives can use the assumed percentage burden. One of the most frequent faults of alternative comparisons is the failure to determine actual incremental effect of the particular change proposed.

One of my favorite stories comes from a large automotive company which was planning a new facility while its current plants were down. The only men working were foremen, and they had little or nothing to do. We were designing equipment for a new plant, and needed some samples. It was cheaper to get the samples made up outside, because we would be charged with the foreman's rate and the regular percentage for burden if the company made the samples. This illustrates the danger of following accounting practices set up for another purpose in making comparisons of alternatives. Many good accountants, in my experience, do not understand the concept of incremental costs—perhaps they should take a course in calculus!

As long as they do not, the engineer has to take account of their shortcomings. Don't forget installation costs and removal costs.

Considerable equipment is purchased without any real advantage in inherent productive efficiency, either knowingly or unknowingly. There are intangible advantages to providing employees with modern equipment, which may pay off in production even though the new equipment is no better than the old. A bus with air suspension will carry no more passengers than a similar one without, but it may preserve the riding habit better.

The typist who has the latest model typewriter is more likely to think the company is interested in her production than if she has one that is ten years old, and shows it.

One other point which may be of interest—the general assumption that maintenance cost increases with age is not borne out in fleet maintenance costs for a fleet of 2000 automative units—maintenance increases immediately after purchase, then drops off gradually until it reaches an approximate level. These records were made less useful by the fact that they were in dollar terms, and changing price levels over the years may have affected the results. No appraisal of efficiency was available.

Author's Closure

IN response to Baxter H. Webb's comments I only have to add the following: In the brief paper the term for depreciation is only a part of the entire formula.

Those wishing to assume a different approach in order to reach a final figure for the influence of the depreciation cost may feel free to do so. Many case histories are mentioned in Grant and Norton's book "Depreciation." As far as the amounts set aside for depreciation purposes or buying a new tool in due time, nothing will be changed in the mathematical setup as developed in the paper. That method of cost analysis I considered the main topic of my paper.

Mr. Webb's comments and interest in the subject are appreciated.

Realf Ottesen.[23]

[21] Director of Administrative Management, City of Detroit (Mich.), Welfare Department, Mem. ASME.

[22] "How to Analyze the Cost of Machine Tools . . . From the Swivel Chair," by Realf Ottesen, MECHANICAL ENGINEERING, vol. 78, November, 1956, pp. 1003–1006.

[23] Project Engineer, Worthington Corporation, Harrison, N. J. Affiliate, ASME.

Reviews of Books

And Notes on Books Received in Engineering Societies Library

Wind Power

THE GENERATION OF ELECTRICITY BY WIND POWER. By E. W. Golding. Philosophical Library, Inc., New York, N. Y., 1956. Cloth, $5^1/_2 \times 8^3/_4$ in. 101 figs., 28 plates, 38 tables, bibliography, xvi and 312 pp., $12.

Reviewed by Philip W. Swain[1]

HAVING finally read this unusual book from cover to cover, the reviewer becomes one "who came to scoff and remained to pray." His original error was to view windmills in the light of the present state of the power art in the United States. Since the famous Grandpa's Knob experiment in New Hampshire there has been almost no interest in the wind as an energy source in this country. Rightly so.

Yet the reviewer is inclined to agree with the English author that wind power could play an important role in the primitive countries of Asia and Africa. For many years thousands of impoverished communities will either do without power entirely or provide it locally in some crude and cheap form. A combination of wind power with local steam or diesel would greatly reduce fuel costs. Of course the combination plants would cost more to install. Who can say who, if anybody, would provide the capital?

Aside from such applications the author quite clearly considers the British Isles as a serious prospect for wind power up to perhaps 15 per cent of the total capacity connected to the Grid.

Assuming no firm capacity for the wind plants, the author would credit them only with the fuel saving in the connected thermal plants—say 0.5 pence per kilowatt hour. He estimates the competing wind energy cost at from 0.25 to 0.9 pence.

Readers should be warned not to draw American conclusions from such figures without detailed examination of the author's economic assumptions or without noting that the British coastal hills are notably more windy than most American sites. Windiness is essential for output of a windmill varies as the *cube* of the wind velocity. Increasing wind from 10 mph to 30 mpg multiplies power output by 27. Thus a 200-ft diameter propellor developing 1700 kw at 30 mph will produce not more than 63 kw at 10 mph. Moral: never try building a wind-power plant for a steady wind of 10 mph.

Subjects discussed at some length in this comprehensive book include history of windmills, estimation of energy obtainable from the wind, wind characteristics and distribution, wind-power sites, wind surveys, wind flow over hills, measuring wind velocity, wind "structure" (gusts, and so on), wind data and energy determinations, testing wind-driven a-c generators, construction costs, relation of wind power to other sources, research and development, international co-operation.

The last named—international co-operation—is the prime reason why some of our public spirited American engineers should give this book serious study.

[1] Consulting Editor of Power. Fellow ASME.

Books Received in Library

DEFECTS AND FAILURES OF METALS. By E. P. Polushkin. 1956, Elsevier Publishing Company. Available in the U. S. from D. Van Nostrand Company, Inc., Princeton, N. J. 399 p., 6 × 9 in., bound. $12.50. A comprehensive and systematic study of the failures and defects of the whole field of metals and their alloys. Each of the various failures or defects—segregation, impurities, residual stresses, fatigue, embrittlement, corrosion, etc.—is accorded a separate chapter which is organized into six sections covering general characteristics, origins, discovery and testing, occurrence, detrimental effects, and prevention. Extensive reference lists accompany each chapter.

DEFORMATION AND FLOW OF SOLIDS. Edited by R. Grammel. (International Union of Theoretical and Applied Mechanics, Colloquium Madrid, September, 1955.) Springer-Verlag, Berlin, Germany. 324 p., $6^1/_8 \times 9^1/_4$ in., bound. DM 37.50. The papers in this volume are presented in three parts devoted to dislocations and plasticity; nonlinear elasticity and miscellaneous problems; and viscoelasticity and relaxation. Specific topics dealt with include dislocations in crystals; brittle fracture in metals; elastic deformations in rubberlike materials; and cavitation damage. About half of the papers are in English, the remainder in French, German, and Spanish.

ELECTRONIC ANALOG COMPUTERS. (D-c Analog Computers). By G. A. Korn and T. M. Korn. Second Edition, 1956. McGraw-Hill Book Company, Inc., New York, N. Y., 452 p., 6 × $9^1/_4$ in., bound. $7.50. This book describes a standard procedure for setting up a computer to solve a given set of differential equations, and presents setups for such practical problems as automobile-suspension systems and industrial-process control. It also covers the design of computing elements, amplifier circuits, and auxiliary components. Developments in analog multiplication and function generation are discussed, and the design and construction of complete computer installations are given for various applications in industry and science. No mathematics beyond differential equations is required of the reader.

ENGINEERING DYNAMICS. Vol. 2. Elastic Problems of Single Machine Elements. By C. B. Biezeno and R. Grammel. Translated from the original German by M. L. Meyer. 1956, Blackie & Son, Ltd., Glasgow, Scotland. 527 p., 7 × $10^1/_2$ in., bound. 90s. This is the second in a series of four volumes devoted to the solution of the more complicated dynamical problems encountered by practical designers and research engineers, especially in steam-turbine and combustion-engine design. The present volume covers beams and shafts, rings, springs, plates, shells, and problems of elastic instability.

ENGINEERING INSPECTION, MEASUREMENT AND TESTING. By H. C. Town and R. Colebourne. 1956, Philosophical Library, Inc., New York, N. Y. 191 p., $5^7/_8 \times 9$ in., bound. $8.75. The greater part of this book is devoted to descriptions of various devices and to brief indications of their applications. The devices covered include comparators, linear measuring machines, multidimension inspection machines, auto-collimators, etc. Also dealt with are the functions of the inspection department, principles of precision measurement, measurement during machining, inspection methods and calculations, screw-thread measurement, and the measurement of surface finish.

HANDBUCH DER SONDERSTAHLKUNDE. By Eduard Houdremont. Third Edition, 1956. Springer-Verlag, Berlin, Germany. 1538 p., $6^3/_8 \times 10$ in., bound. 2 volumes, DM 220. This 1538-page reference work on alloy steels brings together the relevant information contained in hundreds of articles, papers, and reports. Following an opening chapter on the properties and characteristics of pure iron, vol. 1 continues with extensive sections on carbon steels, including full coverage of their heat treatment, and on manganese, nickel, and chromium steels. Vol. 2 deals with tungsten, molybdenum, vanadium cobalts, and silicon as alloying elements, and with the effect on steel of aluminum, copper, titanium, phosphorus, sulphur, various gases, and some of the rarer elements. In each major section the author considers general characteristics, tool steel alloys, structural steel alloys, and

the influence of the particular element on the physical and chemical properties of the steel, and on its manufacture and working. Metallurgical aspects are stressed throughout, with full illustration by means of constitution diagrams, microphotographs, and hundreds of graphs. In addition to the graphs, data tables present in concise form the information contained in the footnote references for which an author index is supplied.

HANDBUCH DER STAUBTECHNIK. Vol. 1: Grundlagen. By Robert Meldau. Second edition, 1956, VDI-Verlag, Düsseldorf, Germany. 289 p., $6^3/_4 \times 9^3/_4$ in., bound. DM 28.50. This first volume of a set dealing with dust problems covers mainly general aspects: Characteristics of dust, both natural and artificial; various types of damage caused by dust; physics of dust particles in gases, both in confined spaces and in the open air; dust explosions and fires; methods of measurement of dust properties. The set is an expansion of an earlier single-volume work on industrial dust by the same author.

Library Services

ENGINEERING Societies Library books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

ASME Boiler and Pressure Vessel Code

Interpretations

THE Boiler and Pressure Vessel Committee meets regularly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th Street, New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in MECHANICAL ENGINEERING.

(The following Case Interpretations were formulated at the Committee meeting Jan. 11, 1957, and approved by the Board on Mar. 5, 1957.)

Annulment of Cases

The following case is annulled:

CASE NO.	REASONS FOR ANNULMENT
1207	Stress values are now included in Tables P-7 and UCS-23 under SA-106, Grade C

Case No. 1224-1

(Reopened) (Special Ruling)

Add the following as new Item 4 in the Reply:

Definitions

The Reactor Vessel is that vessel in which nuclear fuel is present and in which the nuclear chain reaction takes place.

Primary Vessels are those vessels, other than the reactor and containment vessels, which contain or may contain reactor coolant. These vessels may be heat-exchangers, pressurizer tanks, drain tanks, dewatering vessels, etc. Secondary vessels are all other vessels which do not contain reactor coolant or are not otherwise subject to irradiation. Secondary vessels are covered in appropriate sections of the Code.

Containment Vessels are those outer vessels which enclose the reactor vessel or portions of the primary coolant circuit or both. The containment vessels are not normally pressurized and are built to contain the lethal radioactive substances that may be released in case of an accident or failure of the reactor vessel or the primary coolant circuit or both.

Case No. 1141-1

(Reopened) (Special Ruling)

Inquiry: May steel produced to an SA Specification in a foreign country be used in the construction of ASME Code boilers or pressure vessels?

Reply: It is the opinion of the Committee that an SA Specification does not restrict the location of the steel mill producing the material. So long as all specification requirements are met as indicated by a certified mill test report and the evidence is satisfactory to the authorized inspector that the steel was produced by an established and reputable steel mill to such specification, such steel may be used. Such items as surface conditions, cleanliness, and, when required, weldability, shall be satisfactory.

If there is any doubt regarding the data presented, the authorized inspector may call for check tests as provided for in the specification.

Case No. 1226-3

(Reopened) (Special Ruling)

Revise the Inquiry as follows:

Inquiry: May containment vessels as defined in Case No. 1224-1 for nuclear reactor installations be built under Section VIII, Code for Unfired Pressure Vessels, without stress-relieving as specified in Par. UW-2(a)?

Add to the Reply new subparagraph (7) as follows:

(7) Provisions for corrosion shall be made in accordance with Par. UG-25. The mandatory requirements of Par. UCS-25 are not intended to apply to containment vessels.

(*Editorial Note:* This revision deletes the definition of "containment vessels" previously included in this case.)

Case No. 1233

(Special Ruling)

Inquiry: Is it permissible to use cast aluminum bronze material conforming to ASTM B 148-52, Alloy 9D, in Code construction? If so, what design stresses are applicable?

Reply: It is the opinion of the Committee that cast aluminum bronze, conforming to ASTM B 148-52, Alloy 9D, may be used in Code construction. The design stress applicable is 22,500 psi at temperatures subzero to 150 F. A casting factor in accordance with Par. UG-24 shall be applied. Welding shall not be permitted.

Case No. 1235

(Interpretation of Pars. UG-125 to UG-134)

Inquiry: May containment vessels for nuclear reactor installations be built in accordance with Section VIII, Code for Unfired Pressure Vessels, without pressure-relief devices as required by Pars. UG-125 to UG-134?

Reply: It is the opinion of the Com-

mittee that, since it is intended that these vessels be designed and built to safely contain all the lethal radioactive substances that may be released in case of a maximum credible accident affecting the reactor vessel or primary coolant circuit or both, and because of the hazardous character of the materials which might be released, pressure relief devices are not required. If for any reason such devices are installed, adequate provision shall be made for safe disposal of the effluent.

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code . . .

As NEED arises, the Boiler and Pressure Vessel Committee entertains suggestions for revising its Code. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Comments should be addressed to the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th Street, New York 18, N. Y.

Power Boilers, 1956

PAR. A-30(b) Revise the first sentence to read:

For carbon steel material complying with a Code specification and having a specified minimum tensile strength not over 70,000 psi . . . .

Material Specifications, 1956

The Boiler and Pressure Vessel Committee has approved the addition to Section II of the following new specification:

SA 370-54T Methods and Definitions for Mechanical Testing of Steel Products

Unfired Pressure Vessels, 1956

PAR. UG-27(b) Revise the first sentence of E to begin:

E = joint efficiency for or the efficiency of appropriate joint in cylindrical shells and any joint in spherical shells, or . . .

Delete "For seamless shells, use E = 1," and replace with: "Where there is no joint normal to the direction of stress under consideration (e.g., no longitudinal joint when circumferential stress formulas are used), $E = 1$."

PAR. UG-27(c) Revise to read:

(c) *Cylindrical Shells.* The minimum thickness or maximum allowable working pressure of cylindrical shells shall be the greater thickness or lesser pressure as given by (1) or (2) below:

(1) Circumferential stress (longitudinal joints)

When the thickness does not exceed one-half of the inside radius, or P does not exceed 0.385 SE, the following formulas shall apply:

$$t = \frac{PR}{SE - 0.6P}$$

or

$$P = \frac{SEt}{R + 0.6t}$$

(2) Longitudinal stress (circumferential joints)[2]

When the thickness does not exceed one-half of the inside radius, or P does not exceed 1.25 SE, the following formulas shall apply:

$$t = \frac{PR}{2SE + 0.4P}$$

or

$$P = \frac{2SEt}{R - 0.4t}$$

PAR. UG-101(o)(6) Revise the first sentence to read:

As an alternative, the proportional limit for carbon steel material complying with a Code specification and having a specified minimum tensile strength of not over 70,000 psi . . .

[2] These formulas will apply only when the circumferential joint efficiency is less than one-half the longitudinal joint efficiency, or when the effect of supplementary loadings (Par. UG-22) causing longitudinal bending or tension in conjunction with internal pressure is being investigated. An example illustrating this investigation is given in Appendix L (Par. UA-274(a) and (b)).

TABLE UCS-23 Page 74, under "Pipe and Tubes, Seamless Carbon Steel" for both SA-333 Grade C and SA-334 Grade C: delete references to Notes (4) and (6).

Page 76, under Note (14): revise SA-336, Grade F5, to read SA-336, Grade F5a.

Page 76: delete Note (16).

Delete the reference to Note (16) after:

SA-352	LCB
SA-352	LC1
SA-352	LC2
SA-352	LC3

TABLE UNF-23 Revise allowable stress values under Sheet and Plate, Aluminum and Aluminum Alloy Products as shown in the accompanying table.

PAR. UA-2 Revise to read:

UA-2 *Thick Cylindrical Shells.*

(1) Circumferential stress (longitudinal joints)

When the thickness of the cylindrical shell under internal pressure exceeds one-half of the inside radius, or when P exceeds 0.385 SE, the following formulas shall apply:

When P is known and t is desired:

$$t = R(Z^{1/2} - 1) = R_0 \frac{(Z^{1/2} - 1)}{Z^{1/2}}$$

where $$Z = \frac{SE + P}{SE - P}$$

Where t is known and P is desired:

$$P = SE\left(\frac{Z - 1}{Z + 1}\right)$$

where $$Z = \left(\frac{R + t}{R}\right)^2 = \left(\frac{R_0}{R}\right)^2 = \left(\frac{R_0}{R_0 - t}\right)^2$$

(2) Longitudinal stress (circumferential joints)

Revisions to Allowable Stress Values in Table UNF-23

Spec. No.	Alloy	Temper	For Metal Temp Not Exceeding 400 F From	To
SB-178	990A	H12	2100	1700
		H14	2200	1700
SB-178	MG11A	H32	4300	3500
		H34	4700	3500
SB-178	Clad MG11A	H32	4100	3400
		H34	4600	3400
SB-178	G1A	O	2800	2100
		H112	2800	2100
		H32	2800	2100
		H34	2800	2100
SB-178	GR20A	O & H112	3900	3500
		H32	4800	3500
		H34	5300	3500

When the thickness of the cylindrical shell under internal pressure exceeds one-half of the inside radius, or when P exceeds 1.25 SE, the following formulas shall apply:

When P is known and t is desired:

$$t = R(Z^{1/2} - 1) = R_0\left(\frac{Z^{1/2} - 1}{Z^{1/2}}\right)$$

where $$Z = \left(\frac{P}{SE} + 1\right)$$

When t is known and P is desired:

$$P = SE(Z - 1)$$

where $$Z = \left(\frac{R + t}{R}\right)^2 = \left(\frac{R_0}{R}\right)^2 = \left(\frac{R_0}{R_0 - t}\right)^2$$

Symbols are as defined in Pars. UG-27 and UA-1.

PAR. UA-274 Add the following new paragraph:

UA-274 (a) *Cylindrical Shell Under Internal Pressure With Supplementary Loading.* An example of the use of the rules in Par. UG-27(c).

Given: A packed column 24 in. inside diameter and 43 ft long, bend line to bend line, operating under 200 psi internal at 212 F with a longitudinal bending moment of 665,000 in.-lb. The column is to be constructed of SA-285 Grade C carbon steel. Longitudinal joint efficiency, $E = 0.85$. Circumferential joint efficiency, $E = 0.75$.

Required: Shell thickness, t, required with no longitudinal stiffeners.

Solution:

Minimum thickness due to pressure, circumferential stress governing:

$$t = \frac{PR}{SE - 0.6P}$$

$$= \frac{200 \times 12}{13{,}750 \times 0.85 - (0.6 \times 200)} = 0.207 \text{ in.}$$

Thickness due to pressure, longitudinal stress governing:

$$t = \frac{PR}{2SE + 0.4P}$$

$$= \frac{200 \times 12}{2 \times 13{,}750 \times 0.75 + (0.4 \times 200)} = 0.116 \text{ in.}$$

Thickness due to longitudinal bending moment, assuming for a thin cylinder $\frac{I}{C} = \pi R^2 t$:

$$t = \frac{M}{\pi R^2 SE}$$

$$= \frac{665{,}000}{\pi \times 12^2 \times 13{,}750 \times 0.75} = 0.143 \text{ in.}$$

Total required thickness, longitudinal stress governing:

$$t = 0.116 + 0.143 = 0.259 \text{ in.}$$

Since 0.259 in., required thickness when longitudinal stress governs, is greater than 0.207 in., required thickness when circumferential stress governs, the minimum shell thickness is 0.259 in.

(b) *Cylindrical Shell Under Internal Pressure With Supplementary Loading.* An example of the use of the rules in Par. UG-27(c).

Given: Same vessel considered in Par. UA-274(a) with an actual thickness of $^5/_{16}$ in.

Required: Maximum allowable working pressure, P.

Solution:

Maximum allowable working pressure, circumferential stress governing:

$$P = \frac{SEt}{R + 0.6t}$$

$$= \frac{13{,}750 \times 0.85 \times 0.313}{12 + (0.6 \times 0.313)} = 300 \text{ psi}$$

Thickness available to support pressure, longitudinal stress governing:

$$t = 0.313 - 0.143 = 0.170 \text{ in.}$$

(0.143 in. equals thickness required for longitudinal bending. See Par. UA-274(a)).

Maximum allowable working pressure, longitudinal stress governing:

$$P = \frac{2SEt}{R - 0.4t}$$

$$= \frac{2 \times 13{,}750 \times 0.75 \times 0.170}{12 - (0.4 \times 0.170)} = 293 \text{ psi}$$

Since 293 psi, allowable pressure when longitudinal stress governs, is less than 300 psi, allowable pressure when circumferential stress governs, the maximum allowable working pressure for the vessel is 293 psi.

PAR. UA-601(a)(4) Delete the words: "four-fifths of."

PAR. UA-602 Delete.

PART UCN Add a new Part UCN, Requirements for Unfired Pressure Vessels Constructed of Cast Nodular Iron.

FIG. UCN-28 Add Fig. UCN-28, Chart for Determining Shell Thickness of Cylindrical and Spherical Vessels Under External Pressure When Constructed of Cast Nodular Iron, to Appendix IV. Copies of this chart, and Part UCN, are available from the Secretary of the ASME Boiler and Pressure Vessel Committee, 29 West 39th St., New York 18, N. Y.

Welding Qualifications, 1956

Table QN-11.2 Add the following classification numbers under Oxyacetylene and Inert Gas Arc for the respective Filler Alloy Number.

FILLER ALLOY	OXY-ACETYLENE	INERT GAS ARC
F-41 Nickel (0.75 max C)	RN41	ERN61
F-42 Nickel (0.10 max C)	...	...
F-43 Nickel copper (67 Ni-30 Cu-0.40 max C)	RN40	ERN60
F-44 Nickel Copper (67 Ni-30 Cu-0.15 max C)	...	...
F-45 Nickel-Chromium-Iron (77 Ni-15 Cr-7 Fe)	ERN62	ERN62
F-46 Nickel-Chromium (80 Ni-20 Cr)	...	...

Revise the note with the asterisk (*) as follows:

AWS-ASTM Tentative Specification SB-285 for Aluminum; SB-225 and SB-259 for Copper; SB-295 and SB-304 for Nickel.

TABLE Q-11.1

Add the following specification number, minimum tensile strength, and type of material under the respective P-number:

SPEC. NO. & TYPE OF MATERIAL	P NO.	PSI MIN TENSILE
SA-387, Grade A Cr-Mo Plate (0.65-0.55 Mo)	3	65,000
SA-106, Grade C Carbon Steel Pipe	1	70,000
SA-182, Grade F5 Cr-Mo Pipe Flanges (5 Cr-0.50 Mo-0.15 max C)	5	60,000
SA-182, Grade F5(a) Cr-Mo Pipe Flanges (5 Cr-0.50 Mo-0.25 max C)	5	90,000
SA-182, Grade F7 Cr-Mo Pipe Flanges (7 Cr-1 Mo)	5	60,000

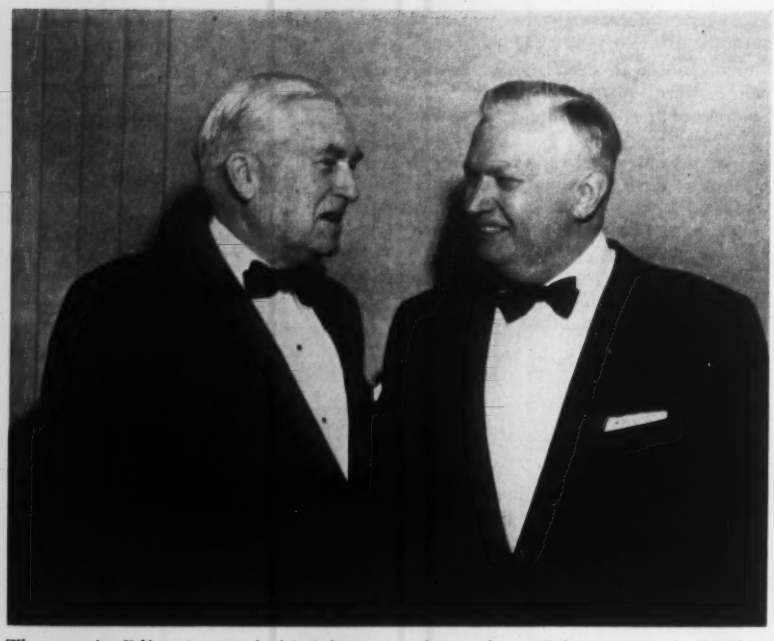
Announcement

Definitions and Explanations of Terms Used in Vessel Design—This has recently been approved by the Boiler and Pressure Vessel Committee in conjunction with Code usage and copies are available from the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th St., New York 18, N. Y.

Roundup

Of Current Engineering Events, News, and Comment

E. S. Newman, *News Editor*



Thomas A. Edison's 110th birthday was observed on February 11 as the first National Science Youth Day to interest young people in science and engineering careers. At the celebration dinner at the Waldorf-Astoria Hotel, New York, N. Y., Honorable Charles Edison, *left*, Honorary President of the Edison Foundation and son of the inventor, chats with Walker L. Cisler, president of The Detroit Edison Company and chairman of the National Edison Birthday Celebration.

Atomic Energy Leader, W. L. Cisler, Says Young Talent Needed

An internationally known leader in the peaceful development of atomic energy said that "the atomic power field in itself can put to excellent use 10,000 trained men and women in the next two years."

Walker L. Cisler, Fellow ASME, president of the Detroit Edison Company and of The Fund for Peaceful Atomic Development, spoke at the first National Science Youth Day Dinner at the Waldorf-Astoria Hotel, New York, N. Y., February 11, 1957, about opportunities for scientific and engineering careers for young people.

Pointing out that undeveloped young talent is of little value either to the child or to America, Mr. Cisler said that the shortage of scientific personnel is "part of a larger problem involving the need for competent people in all walks of life. Our objective must be the full development of all our intellectual resources."

Speaking before 650 educators, industrialists, and Government officials on the occasion of Thomas Alva Edison's 110th birthday, Mr. Cisler stated, "the potential sources of nuclear energy are probably more than 23 times greater than all known conventional fuels."

Observing that "civilization is completely dependent upon energy," he stated that full use must be made of nuclear materials "with help from our growing understanding of fast breeder technology."

Mr. Cisler is chairman of the National Edison Birthday Celebration, a nationwide program of co-operation between industry, government, and education to interest young people in science. He pointed out that Thomas Edison lived in a country where he could use his full talents, and that ". . .the society in which (scientists) live must also favor free inquiry and affirm the rights of initiative."

The annual observance of Edison's birth as National Science Youth Day is under the auspices of the Thomas Alva Edison Foundation. The week of February 11 was marked through this country and abroad by visits of high-school students to research laboratories and plants, and school activities.

Among those participating with the United States Atomic Energy Commission, which opened its nonweapons laboratories to high-school visitors for the first time on February 11, were: General Motors; Ford Motor Company; Chrysler Corporation; the Atomic Industrial Forum; and the Edison Electric Institute.

As part of the program, the Foundation's Honorary President, the Honorable Charles Edison, former Governor of New Jersey, presented the Edison Foundation's Children's Book Awards, a division of the annual National Mass Media Awards Program.

The Edison Foundation National Mass Media Awards Program was established in 1955, in co-operation with 62 national organizations, to encourage more wholesome influences for youth in the mass media and to interest boys and girls in science.

Eleventh Sectional Meeting, WPC, to Be Held in Belgrade

THE Eleventh Sectional Meeting of the World Power Conference will be held in Belgrade, Yugoslavia, from June 5 to 11, 1957. The main theme is: "Power as a Factor of Development of Underdeveloped Countries."

The Technical Program has been divided into main divisions A and B and sections A.1 to A.10 and B.1 to B.5 and is available in English, French, German, and Russian. Technical sessions have been arranged for the discussion of the papers submitted, having regard to their contents and number. Most of these sessions will take place in the large Hall of the Trade Unions Building; some will be held in smaller meeting-rooms of the same building.

During the Sectional Meeting there will be whole-day and half-day excursions to power plants and industrial enterprises located in Belgrade and its neighborhood.

Arrangements have been made for a number of events to take place during the week of the meeting. These include the opening meeting, receptions given for the participants, and special performances at the theatres of Belgrade.

Whole-day and half-day trips through the immediate and more distant surroundings of Belgrade, as well as conducted sight-seeing tours of the city and visits to other places of interest, have been arranged for the ladies.

Arrangements have also been made for a number of postconference tours to various hydroelectric plants, thermal plants, and industrial establishments in Yugoslavia. The itinerary has been chosen so as to provide for visits to places of historical interest and to give participants the opportunity of seeing some of Yugoslavia's beautiful scenery.

Technical Sessions

The papers submitted to the Eleventh Sectional Meeting of the World Power Conference will not be read at the technical sessions. This is to keep all the available time free for discussions. The General Reporter will give only an introduction to the topic for discussion. The General Reports will be printed in the four working languages; preprints of them will be forwarded to participants in good time.

The papers as well as the General Reports will be published in full in the Transactions of the Eleventh Sectional Meeting of the World Power Conference, which will also contain summaries of the discussions, the Chronicle of the Conference, a list of participants, and an Index.

The preprints of the reports can be guaranteed only to those who pay the membership fee of U. S. $50, or the equivalent in the currency of the participant's country, by April 1, 1957.

For the necessary applications and latest meeting information, interested persons are urged to query General S. E. Reimel, Secretary, U. S. National Committee, World Power Conference, c/o EJC, 29 West 39th Street, New York 18, N. Y., as soon as possible.

The discussions during the Technical Sessions will be held in one of the four working languages and be simultaneously translated into the other three.

Technical Program

Division A: **Economic Aspects**

Division B: **Technical Aspects**

Section B. 1	Integral utilization of water resources.
Section B. 2	Integral utilization of low-quality solid fuels.
Section B. 3	Utilization of nuclear power.
Section B. 4	Power and agriculture.
Section B. 5	Power for the metallurgical, chemical, and other industries.

Symposium on Engineering Aspects in the Nuclear Field, New York University, April 13, 1957

A ONE-DAY symposium on "Engineering Aspects in the Nuclear Field" has been scheduled for Saturday, April 13, at the Gould Student Center Auditorium, University Heights Campus, New York University. The meeting is under the joint sponsorship of the Metropolitan Section, ASME, and the College of Engineering, New York University.

By inviting experts in the various fields to present papers ranging from educational requirements to practical design problems, it is hoped that the meeting will be of interest not only to professional engineers in the Nuclear field, but also to others who would like to become acquainted with the problems and challenges of Nuclear Energy.

The program is as follows:

9:15 a.m.

MORNING SESSION

Introduction—Thorndike Saville, dean, College of Engineering, New York University

Educational Background for the Nuclear Field, by *Prof. H. J. Gomberg*, University of Michigan

Nuclear-Power Plants, by *A. C. Stanojev*, Duquesne Light and Power Co.

Mechanical Design, by *C. W. Hammond*, The Babcock and Wilcox Co.

12:30 p.m.

Luncheon

Speaker: *S. Strauch*, Atomic Energy Commission

2:30 p.m.

AFTERNOON SESSION

Heat Transfer, by *Dr. S. Levy*, General Electric Co.

Control Problems, by *Dr. J. N. Grace*, Westinghouse Electric Corp.

Details regarding registration, directions, and so on may be obtained by writing Prof. F. Landis, Department of Mechanical Engineering, New York University, New York 53, N. Y.

Management Conference, April 11, Announced by ASME Region I

THE preliminary announcement of the Management Conference to be held by The American Society of Mechanical Engineers, Region I, on April 11, 1957, at the Wachusett Country Club, West Boylston, Mass., lists William F. Ryan, ASME President, as principal dinner speaker.

The program for the one-day conference begins at 2:00 p.m. with registration followed by the afternoon session, cocktail hour, dinner, and concludes with an evening session. There will be a $10 fee per person.

The technical program includes the following papers:

Integrated Business Measurements in Industry, by *Allen Keller*, General Electric Co., Lynn, Mass.

The Logic of Organizational Planning, by *T. F. Koch*, Chicago Rawhide and Manufacturing Co., Chicago, Ill.

The Problem of Training the Creative Engineer, by *C. D. Orth, 3rd*, E. D. Chapple Co., Noroton, Conn.

Management of Engineering Personnel, by *F. L. Ryder*, Republic Aviation Corp., Farmingdale, Long Island, N. Y.

People

Honors and Awards. HAROLD H. BEVERAGE, one of radio's outstanding pioneer scientists and engineers, vice-president of the Radio Corporation of America, and director of the RCA Laboratories, has been awarded the 1956 Lammé Gold Medal by the American Institute of Electrical Engineers. The medal will be presented at the summer general meeting of AIEE in Montreal, Canada, June 24.

ROBERT ANNAN, internationally known mining engineer and chairman of the Consolidated Gold Fields of South Africa, Ltd , of England, was named recipient of the 1957 Egleston Medal, Columbia University's highest award for "distinguished engineering achievement." The medal will be presented May 9, at a dinner to be held at the Columbia University Club in New York City.

WALTER H. ZINN, former director of Argonne National Laboratory at Lemont, Ill., was honored March 27 at the American Power Conference. He was presented with the conference's Certificate of Merit, the second to be awarded by the conference in its 19-year history, in recognition of his contributions in the field of nuclear power generation and pioneering achievements in atomic research. He was a member of Dr. Enrico Fermi's group at the University of Chicago, identified with the first nuclear chain reacting pile in 1942.

The first presentation of two awards, to be given annually for outstanding service to standardization and to standardization literature, has been made by the Standards Engineers Society. Both awards for 1956 were made posthumously to DR. DICKSON RICK, editor of the new book, "National Standards in a Modern Economy." (See "Reviews of Books" in the March, 1957, issue of MECHANICAL ENGINEERING, pp. 295-296.) These awards of $100 each have been made available by the American Society for Testing Materials for presentation annually by the Standards Engineers Society.

Three young aeronautical engineers were the initial recipients, March 6, of newly established Engineering Achievement Awards given by the El Segundo, Calif., division of Douglas Aircraft Company to engineering employees making "outstanding contributions to the science of aeronautics." The first annual awards were presented to T. E. ABRAHAM, power-plant engineer, for the "development of the first successful aircraft in-flight fueling store"; M. J. ABZUG, aerodynamicist, for "developing equations of motion of an airplane which are extremely valuable for studies of armament fire control in fighter airplanes"; and L. F. KURRASCH, automatic controls specialist, for "development of an auto-control system for high performance fighter airplanes."

New Officers. H. G. ARLT, Bell Telephone Laboratories, Murray Hill, N. J., has been elected president by the Standards Engineering Society for 1957, with F. E. POWELL, Mem. ASME, Standards Branch, Deputy Chief of Staff, Logistics, Department of the Army, as vice-president.

JAMES W. DUNHAM, vice-president in charge of industrial gas production, engineering, and research, National Cylinder Gas Company, Chicago, Ill., was elected president of the Compressed Gas Association.

Lecturers. MORRIS COHEN, professor of physical metallurgy at Massachusetts Institute of Technology, delivered the annual lecture of the Institute of Metals Division of the American Institute of Mining, Metallurgical, and Petroleum Engineers at their annual meeting in New Orleans, La., Wednesday, February 27. The lecture was given in the Jung Hotel on the subject, "Nucleation of Solid-State Transformations." This lecture, established in 1921, is one of the outstanding events in the world of physical metallurgy. Mr. Cohen has been active in the fields of phase transformations, metallography, heat-treatment, solid-state diffusion, thermodynamics, mechanical behavior of metals, tool steels, and age hardening.

EDMUND S. DAVENPORT, assistant to vice-president, research and technology, United States Steel Corporation, delivered the 34th annual Henry Marion Howe Memorial Lecture at the AIME annual meeting, Tuesday, February 26. Mr. Davenport spoke on "Some Observations on Ferrite-Carbide Aggregates in Alloy Steels." This lecture is given in respect to the memory of Mr. Howe, who was a past-president of the Institute.

LIEUT. COL. L. URWICK, Calvin W. Rice Lecturer and Life Mem. ASME, management consultant, and author of management textbooks, began a four-month lecture tour of the United States on Feb. 23, 1957. His subject is the scientific approach to management problems in industry, especially in organization at senior levels, and in the education of future managers.

Lester M. Goldsmith, *center*, Fellow ASME, is cited as "Philadelphia Engineer of the Year" at a luncheon held Feb. 21, 1957, at the Engineers' Club, Philadelphia, Pa. The occasion highlighted National Engineer's Week. Dr. Goldsmith is general manager of engineering and construction of The Atlantic Refining Company. Allan H. Kidder, *left*, vice-president of the National Society of Professional Engineers, makes the presentation as John L. Bahr, *right*, National Engineer's Week chairman, waits to congratulate the recipient.

FRANK W. HURD has been appointed director of research of Union Carbide Nuclear Company, a division of Union Carbide and Carbon Corporation. Dr. Hurd has been identified with Union Carbide's activities in the atomic energy field since 1943 when he joined the Manhattan Engineering District project at Columbia University as a senior research scientist.

D. W. R. MORGAN, past-president and Fellow ASME, has been made a trustee of Drexel Institute of Technology, Philadelphia, Pa.

Campus Data. Major University of Cincinnati appointments, effective Sept. 1, 1957, were recently announced. HOWARD K. JUSTICE, professor of mathematics, will become dean of the College of Engineering, and CORNELIUS WANDMACHER, professor of civil engineering, will become associate dean. C. ALBERT JOERGER, Mem. ASME, dean of the College of Engineering, will retire next summer.

William F. Durand, *center,* past-president and Hon. Mem. ASME, receives a scroll of commendation and appreciation from the Community Councils of the City of New York. The presentation was made by Frank Peer Beal, *left,* president of Community Councils, as C. E. Davies, *right,* secretary, ASME, looks on. Dr. Durand, "Dean of American Engineering," was the guest of honor at a Community Council's Luncheon held February 28; he celebrated his ninety-eighth birthday, March 5, 1957. Dr. Durand first established a national reputation for his classic series of tests investigating the performance of marine propellers. After his "retirement" in 1924 he turned to air-propellor research, working at the Stanford University wind tunnel. Also during the late 1920's he compiled his encyclopedic, six-volume "Aerodynamic Theory," long the standard work in the field. During World War II when he was over eighty years of age he was chairman of the Engineering Division of the National Research Council. Although he has received most of the outstanding awards in the field of aeronautics, and has been honored by dozens of engineering and scientific groups at home and abroad, he did not formally receive his undergraduate college degree until 1956, when a group of leading engineers took advantage of an act of Congress to apply on his behalf for a BS degree from the United States Naval Academy. He had completed a four-year course there in 1880 at a time when no degrees were conferred on graduates.

Coming Meetings

Systems for Information Retrieval

THE School of Library Science of Western Reserve University, in conjunction with its Center for Documentation and Communication Research, will present on April 15-17, 1957, a comprehensive demonstration of systems presently in use for the organization, storage, and retrieval of recorded information, together with a symposium on information-handling problems and techniques and a model information center.

Cosponsor of these activities is the Council on Documentation Research, a group recently formed by representatives of organizations in government, industry, and education for the stimulation of effective co-operation among those who produce, organize, and use information of all types in all fields.

An outgrowth of the Conference on the Practical Utilization of Recorded Knowledge held in Cleveland, Ohio, January, 1957, this three-day program will bring together 20 or more information systems devised or adapted by their users to meet specific problems. Machines needed to make the presentations most effective will also be demonstrated, but the emphasis is to be on working systems.

Oil Burning

A NATIONAL conference on oil burning and its equipment will be held at the New York University College of Engineering on April 15-17. Authorities from industry and education will discuss topics ranging from air pollution to chemical additives for fuel.

The conference, sponsored by the Oil Heat Institute of America and the mechanical-engineering department at NYU, will be held in the Gould Student Center on the University Heights campus, New York, N. Y. Inquiries should be addressed to the Oil Heat Institute of America, 500 Fifth Avenue, New York 36, N. Y.

Nuclear Tests for Nondestructive Testing Applications

NONDESTRUCTIVE tests developed in the field of nuclear energy will be the subject of a symposium to be held at the Morrison Hotel, Chicago, Ill., April 16-18. Information resulting from 15 years' research and development in testing applications in the nuclear field will be presented for the benefit of those interested in applying nondestructive test methods to industrial applications. Recently declassified papers will be presented. They will be divided into three categories: (*a*) reactor materials, including the following: fuel, sheath or cladding, control and moderator material; (*b*) completed fuel assemblies; and (*c*) miscellaneous.

Papers will not be available prior to the meeting, but all will be published by the American Society for Testing Materials after presentation.

The symposium is being sponsored jointly by the American Institute of Chemical Engineers, The American Nuclear Society, the American Society for Testing Materials, and the Society for Non-Destructive Testing.

Instrumentation

THE Third Flight Test Instrumentation Symposium will be held at the Statler Hotel in Los Angeles, Calif., April 29-May 2. The meeting is sponsored jointly by the Los Angeles and the Mojave Desert Sections of the Instrument Society of America in co-operation with the ISA Aeronautical Division's Flight Test Committee.

Mohamed Mortada, *left in photo, left*, senior engineer, Magnolia Petroleum Company, Dallas, Texas, receives the Alfred Noble Prize at the Annual Meeting of AIME in New Orleans, La., from the Institute's outgoing President, Carl E. Reistle, Jr., Houston, Texas. The Prize, awarded by the four Founder Societies and the Western Society of Engineers, consists of a $400 cash award and a certificate. It is based on a technical paper of particular merit, published by one of these societies, whose author is not over 30 years of age when the paper is accepted in practically its final form. For the same paper Dr. Mortada also received, at the AIME convention, its Rossiter W. Raymond Memorial Award. His paper, "A Practical Method for Treating Oilfield Interference in Water-Drive Reservoirs," was published in the AIME Journal of Petroleum Technology. Dr. Mortada is a member of AIME. Herbert Hoover, Jr., *right in photo, right*, former Under Secretary of State, receives at the New Orleans convention of AIME the Hoover Medal, sponsored by the four Founder Societies and awarded by engineers to a fellow engineer for distinguished public service. The presentation was by H. Dewitt Smith, *left*, past-president of AIME. The Medal is named after the recipient's father. The former President of the United States was its first recipient, in 1930. Both are AIME members, the father being Senior Past-President of the Institute.

The technical program features a sequence which is designed to follow the chronology of the flight-test instrumentation system in miniature and will feature morning panel sessions, followed by technical workshops in the afternoon, dealing with more specific aspects of the discussions generated in the morning meetings. Topics of the morning panel sessions will be: "Optimum Aspects of an Instrumentation System," "Limitations of Current Instrumentation Systems," and "Advanced Instrumentation Techniques," respectively.

The afternoon technical workshops will deal with such topics as: instrumentation facility management, practical accuracy of airborne components and systems, review of magnetic tape recording progress, in-flight calibration techniques, transducers versus flight environments, and advance recording techniques.

An additional feature of each afternoon program will be a panel forum conducted by the ISA Missile Test Committee. "Over-Instrumentation," "Correlation Between Missile Static Test and Flight Test Data," and "Power Spectro Density Techniques" are the subjects of these panels.

For further details, write: Eugene Spencer, Los Angeles Section, Instrument Society of America, Office of the Secretary, 5225 Wilshire Boulevard, Los Angeles 36, Calif.

Materials Handling

THE 7th National Materials Handling Exposition, with about 250 companies participating, will be held at Convention Hall, Philadelphia, Pa., April 29–May 3, 1957.

The show and conference will emphasize systems of materials handling rather than any particular piece of equipment. Over 100 types of equipment will be demonstrated.

Theme for the 1957 show will be "Materials Handling, Key to Automation."

Thirty-two speakers will address the conference conducted by the American Materials Handling Society, April 30–May 2. On May 1, the society will hold its annual banquet at the Bellevue-Stratford Hotel, where awards and honors will be presented.

Engineers and Architects

THE fourth annual Conference for Engineers and Architects (ACE), sponsored by the College of Engineering at Ohio State University, Columbus, Ohio, is scheduled for Friday, May 3, 1957, on the Ohio State campus.

Philip Sporn, Hon. Mem. ASME, president of the American Gas and Electric Service Corporation, will be the keynote speaker at the general session. Dr. Sporn, a distinguished engineer, executive, and administrator, is a pioneer in the advancement of practices in electric-power generation, transmission, and distribution—including the applications of nuclear energy.

The luncheon session speaker will be Emanuel R. Piore, director of research for the International Business Machines Corporation, and outstanding physicist and research administrator. He was formerly chief scientist for the Office of Naval Research.

Registration and the general session will take place in the University's new Mershon Auditorium, with the luncheon session to follow at the Ohio Union. The afternoon will be devoted to technical sessions in the various departments of the College of Engineering.

High School Day and Engineering Open House from 4:00 p.m. to 9:30 p.m. will end the day's activities.

Power Show

THE 48th annual exposition and Power Show of the University of Texas will be held Friday evening, May 3, 1957, from

6:00 p.m. to 10:00 p.m. on the campus at Austin.

All the departments of the College of Engineering, College of Pharmacy, the Home Economics Department, and the Army, Navy, and Air Force ROTC units will combine their efforts to provide an educational and interesting display of equipment and techniques employed in training the modern student in these fields. Exhibits ranging from the serious and technical to the extremely imaginative will express the ingenuity of the students presenting the various displays.

Rockets and Missiles

"The Age of Space," will be the theme of a symposium sponsored by the Southern Research Institute, Birmingham, Ala., May 15-16, 1957. Seven discussions are scheduled for the first day. Such diverse subjects as the IGY Earth Satellite Program, materials for space vehicles, missiles and defense, space medicine, and others, will be discussed. A nationally known speaker will present each subject.

A visit to Redstone Arsenal and the Army Ballistic Missile Agency at Huntsville, Ala., is planned for the second day. These agencies have planned an interesting program that will include a demonstration of rocket test firing.

The main purpose of the symposium is to focus attention on the tremendous significance, both to industry and technology, of current developments in the rocket and missile field.

Conference on Radiation Hazards to Mankind Held in New York

The National Committee on Radiation Protection has cut to one-third the "maximum permissible dose" of radiation to which individuals should be exposed, it was disclosed recently by Lauriston S. Taylor of the National Bureau of Standards.

At the same time, James F. Crow, professor of genetics at the University of Wisconsin, stated that as far as genetic effects are concerned, "there is no 'safe' dose (of radiation); each dose, however small, causes a risk of genetic harm proportional to the dose."

Dr. Taylor and Dr. Crow were among the speakers at a symposium dealing with Radiation Hazards to Mankind, sponsored by the Sloan-Kettering Institute for Cancer Research, and Hunter College, Graduate Division, and held at Hunter College, New York, N. Y., on Feb. 20, 1957.

One-thousand high school and college science teachers and others heard leaders in science and education discuss the biological effects of atomic radiation and the implications of the radiation problem for educational programs. The one-day conference was held at Hunter College which conducts a graduate program with Sloan-Kettering for the training of research workers in biochemistry and biophysics.

Dr. Taylor defined maximum permissible dose as "the dose of radiation that a person can receive under specified conditions without serious likelihood of harm resulting to the individual himself." Dr. Taylor stated that "with the new recommendations, we are practically at rock bottom. It will be extremely difficult to lower them any further and still permit the effective use of radiation either in medicine, industry, or research."

Dr. Taylor Said

Speaking at the evening session, Biological Effects of Atomic Radiation, Dr. Taylor described the establishment of the maximum permissible dose levels of radiation by the National Committee. The Committee is a voluntary group of experts, first established in 1929, of which Dr. Taylor is chairman. The new radiation standards, according to Dr. Taylor, take into consideration the quantitative knowledge that is being developed on the effects of radiation on the genetic system and on life expectancy.

In 1935, the "permissible dose," established by the National Committee was 0.1 roentgen per day (0.5 per week); in 1946, 0.3 per week; the dose now has been lowered to 5.0 roentgens per year (0.096 per week). (A roentgen is a standard unit of radiation. Background and other x rays of natural origin deliver approximately 0.1 roentgen per man per year. Radiation delivered by individual medical x-ray procedures varies from 0.5 roentgen to 5.0, depending upon the procedure carried out.)

The new standard differs from that previously set not only quantitatively but in that "it is now tied to a person's age rather than expressed in a given dose per week." The National Committee recommendations stipulate that at any age a person will not have received a dose greater than 5 times the number of his age over 18. "By this means," said Dr. Taylor, "we will hold down the total accumulated exposure at the earlier ages where it is important and still allow the use of radiation under conditions where we can continue with its beneficial employment."

"In setting the new levels," Dr. Taylor stated, "prime consideration has been given to holding down the total dose that may be accumulated

A teaching tool at the New York University College of Engineering is this 12 × 5 × 5-ft petroleum plant model built by The M. W. Kellogg Company, New York, N. Y. The model is on loan to Dr. Charles J. Marsel, NYU associate professor of chemical engineering, *far right*, for use in his senior class in organic technology. Eventually it will go to The Pure Oil Company, whose Lemont, Ill., catalytic reforming process unit it represents. Others examining the model are, *from left:* Percy A. Maschwitz, process engineer in the Pure Oil Refinery technical department; Harold Kershaw, supervisor of plant layout for The M. W. Kellogg Company; and Dr. W. F. Krause, technical manager of Pure Oil's Lemont refinery.

by the population during its reproductive period. This is to protect not only against damage that may show up in the individual but that may possibly show up in future generations."

The new levels, which include radiation received for medical reasons, from natural background, from atomic fallout, and from occupational exposure, are set at 14,000,000 roentgens per million population. "The important thing," stated Dr. Taylor, "is the total dose to those million persons. The dose to the individual is only of secondary importance, so long as it remains within reasonable limits."

Dr. Crow Said

Dr. Crow stated that genetic considerations must be primary in determining the average amount of radiation to which the population is exposed. "Radiations cause permanent changes, *mutations*, to occur. . .The probability that a gene will mutate is strictly proportional to the amount of radiation received. Furthermore, it doesn't make any difference how the radiation is received, i.e., whether gradually or all at once, and very little difference what kind of radiation." Dr. Crow emphasized, "There is no dose too low to cause genetic effects. . . .The most frequent class of mutations is that causing a minor change for the worse—a decreased life expectancy, increased susceptibility to disease, and so on. A mutant which causes a small amount of harm to the individual may do just as much harm to the population as one causing a greater harm."

Uncontrolled Radioactivity

Merril Eisenbud, manager of the New York Operations Office, and Director of the Health and Safety Laboratory of the Atomic Energy Commission, said that while the hazards of uncontrolled radioactivity are serious, "so are the hazards of uncontrolled fire."

"More is known about the biological effects of radioactivity than is known about many man-made hazards to which people are daily exposed," he said. Less research money was spent in the last five years on air-pollution effects, for example, than in three weeks of research on radioactivity effects, the AEC official said.

"There will be accidents in the nuclear field just as in other industries," Mr. Eisenbud pointed out. "Actually, the hazards of working with radioactive materials can be compared in many ways with the risks of working with toxic chemicals. . . .The public must learn to live with nuclear radiation in the same way it does other forms of energy and power."

"Research and industrial radiation," he emphasized, "are in no way similar to hazards from nuclear or thermonuclear weapons. . . .There is no basis for the persistent and almost superstitious belief that the radioactive materials encountered in plants and laboratories are capable of bomblike explosions."

On the subject of radiation hazards in medicine, Dr. Russell Morgan, Radiologist-in-Chief, The Johns Hopkins Hospital, pointed out that information on the harmful effects of radiation on the body has been accumulating for the past 60 years. Though safe operating conditions are not universally used, considerable progress has been made, he said, "and perhaps the public can be given more reassurance regarding the dangers of radiation exposure than is evident in some of the recent reports concerning the subject."

Technical Education Topic of Columbia University Engineering Conference

Science instruction and staffing problems in secondary and primary schools were the subjects of the second of three conferences of a Joint Program for Technical Education, conducted by the Columbia School of Engineering at Arden House, Harriman, N. Y., February 12 to 15. The program, which is supported by the Hebrew Technical Foundation of New York, was established to work out ways and means by which engineering schools, colleges, and industry can help out hard-pressed secondary and primary-school science departments.

More than 100 secondary-school educators, representatives of industry, and engineering schools met to hear authorities in the field and to discuss the material presented. The experts spoke in the morning sessions and discussions took place in the afternoon.

M. H. Trytten, Office of Scientific Personnel, National Academy of Sciences-National Research Foundation, spoke of the changing role of science in the basic requirements of our present and future civilization.

Changing Role of Science

"We have seen, in a little more than a generation," said Dr. Trytten, "the creation of this great technological civilization, from one based on skills and crafts to one based on applied science and upon the skills and knowledge of professionally trained personnel. I am told that there are 6000 persons on the payroll of one company now, who are classified as mathematicians. The important fact is that these needs for personnel of advanced training are now a basic requirement, without which the activities of our economy could not function."

Dr. Trytten pointed to the effect of this on the teaching profession, in which the flow of highly trained persons into teaching was all but stopped by the competition from industry, and suggested that fundamental changes in education would be necessary, if we are to continue to train these people.

"I do not believe we can solve our problems in education today by merely adding a course here or subtracting one there in a sort of game of musical chairs with courses already in the curricula," he said. "Speaking of three objectives which must be striven for in education today," Dr. Trytten continued, "one of these is to present to the present generation the best thought and experiences of mankind in the past. A second objective is to present the basic environment as fully as time permits. . . . the third objective is to give each of our youths such skills and such knowledge as he may need to be a useful and productive member of society."

Pointing out that persons with engineering training are more and more in demand, not only for specialties but for managerial and administrative occupations, Dr. Trytten continued: "I should like to emphasize this point particularly with respect to the problem of teaching. If needed, the curriculum in the nonsciences is to be best adapted to the needs of the technological age. It is doubtful if this can be done so readily by people, who themselves, have little or no concept of science, its meaning, and its genesis. I think it can be asserted that even in the teaching of the nontechnical branches, this is to be done with due regard to the role of science in world affairs."

"We have been too complacent," he said, "with the precious formative years of youth, the high-school age. In this age of crowded curricula, pro-

liferating science information and greater demands on professional training, somehow we must begin earlier, build more carefully the structure of our secondary school curricula, and seek to prepare more people to be more clearly ready for the next steps up the academic ladder."

The conference heard a number of plans whereby teaching salaries could be augmented by other work in cooperation with industry.

Various Opinions

Samuel Schenberg, Supervisor of Science for the New York City Board of Education, told the meeting of the Industry-Education Committee, which is successful in planting a growing number of teachers in industry from the New York School system in summer employment. Under the plan, in the summer of 1956, 17 industrial firms and laboratories employed teachers in a variety of jobs at an average salary of $100 per week.

Austin W. Fisher of Arthur D. Little, Inc., Cambridge, Mass., described "The Lexington Plan," by which science graduates are hired in pairs by that company. The two alternate every six months for three years at industrial research with the company and at teaching in neighborhood schools in the Boston area. According to Dr. Fisher, the supplemented income and the opportunity to advance and do challenging work at the same time have encouraged potentially gifted teachers to go into the profession, where they might otherwise have hesitated under the discouraging pressure of low salaries and doubtful prestige.

In the area of science-teacher training, Paul W. Briggs, Superintendent of Schools, Bay City, Mich., reported on their in-service training plan, whereby every teacher in the school system spends two hours a week studying science, so that every teacher is a science teacher. The training sessions are held during the regular school periods with Bay City parents having agreed to cutting the school week for their children by two hours.

Other speakers at the Joint Program for Technical Education were Saul L. Geffner, chairman of the science department of Forest Hills High School, who outlined an approach to re-establish chemistry in high school as an analytical laboratory course to bring able seniors through a college level course; and William S. Lane, principal of Vashon High School, Burton, Wash., who told of his success in developing prize-winning science students on a small budget.

Meetings of Other Societies

April 14–16
IRE, national symposium on telemetering and exhibits, Sheraton Hotel, Philadelphia, Pa.

April 14–17
Building Research Institute, annual meeting, The Greenbrier, White Sulphur Springs, W. Va.

April 15–17
Western Reserve University, School of Library Science, symposium on systems for information retrieval, Masonic Auditorium, Cleveland, Ohio

April 28–May 2
AAAS, annual meeting Southwestern and Rocky Mountain Division, Tucson, Ariz.

April 28–May 7
German Industries Fair, Hannover, Germany

April 29–May 1
Association of Iron & Steel Engineers, spring meeting, Netherland Plaza, Cincinnati, Ohio

April 29–May 3
American Materials Handling Society, 7th annual conference and exposition, Convention Hall, Philadelphia, Pa.

May, 1957
Ministry of Transport, Italy, first international congress of funicular transport, Rome, Italy

May 1–3
Society for Experimental Stress Analysis, spring meeting and exhibit, Statler Hotel, Boston, Mass.

May 6–8
American Petroleum Institute, annual pipeline conference, Cleveland Hotel, Cleveland, Ohio

May 6–10
American Foundrymen's Society, first engineered castings show and 61st AFS castings congress, Music Hall, Cincinnati, Ohio

May 12–16
The Electrochemical Society, Inc., Statler Hotel, Washington, D. C.

May 13–15
Purdue University, 12th industrial waste conference, Purdue Memorial Building, Lafayette, Ind.

May 13–16
American Petroleum Institute, midyear meeting, refining division, Sheraton Hotel, Philadelphia, Pa.

May 14–16
Illinois Institute of Technology, second annual industrial nuclear technology conference, Museum of Science and Industry, Chicago, Ill.

May 16–17
American Institute of Industrial Engineers, 8th annual national conference and convention, Hotel Statler, New York, N. Y.

May 16–19
Society of Naval Architects and Marine Engineers, spring meeting, Hotel Lafayette, Long Beach, Calif.

(For ASME Coming Events, see page 413)

Industrial Films

Seamless Steel Tubing

"Walls Without Welds," a 28-min presentation of the United States Steel Corporation, shows seamless steel pipe and tubes and the modern methods used in their manufacture.

The basic steelmaking processes are reviewed and a detailed discussion of the development of the seamless steel pipes and tubes follows. The white-hot ingot is followed step by step through the rolling mills, clearly portraying the shaping into blooms, then rounds and billets—reheating the billets in the hearth furnace—then piercing the solid billets, the heart of the seamless process.

The pierced thick-walled tube then is shown on its way through various operations of rolling, reducing, polishing, rounding, and still further rolling in the stretch-mill, where the wall thickness and the diameter are reduced simultaneously. After cooling and straightening, the pipe is cut to length and sped along for finishing operations—threading, inspection, testing, stenciling, and oil coating.

The film is available in Technicolor on one 16-mm 1200-ft reel, or on three 35-mm 1000-ft reels. Running time is 28 min. For distribution information, write: New York Film Distribution Center, United States Steel Corporation, 71 Broadway, New York 6, N. Y. The film is also available for foreign distribution.

Multiple-Head Conveyer-Type Abrasive Belt Grinders

"Two Heads Are Better Than One," a 16-mm 18-min color film, with narration, features the multiple-head conveyer-type abrasive belt grinders manufactured by Engelberg Huller Company, Syracuse, N. Y.

Developed from a coast-to-coast survey of machine installations, the film shows action sequences of various models in production on ferrous, nonferrous, plastic, and other materials. With from two to six grinding heads and conveyerized through-feed, this belt permits multiple grinding operations in the same time as formerly required for a single operation, with no added labor requirements.

A four-head model, using a series of progressively finer grit belts, is shown surfacing chain-saw bars in a single automatic grinding sequence. A two-side adaptation, with grinding heads on

"Two Heads Are Better Than One" includes such sequences as surfacing both sides of copper-plate phenolic sheets on an Engelberg abrasive belt grinder. Machine removes 0.001 in. from each side of sheets, so that graphite coating remains only in perforations scored in parts. Operating time required to meet daily production quota of sheets, which form the thousands of printed circuits utilized in U. S. Air Force SAGE computers, was cut from 16 man-hours to only one.

different levels and a turnover conveyer setup, is shown finishing both sides of phenolic printed-circuit sheets. Included in this sequence is the operation which the Engelberg model replaced with a 16-to-1 production increase.

A new automatic rotary abrasive belt grinder for high-speed precision grinding and finishing of outside diameters is also featured. Representative of special-purpose models developed by Engelberg, the machine is equipped with rotating motor-driven work table, pneumatic infeed, and table oscillation device.

Address requests on company letterhead, with name and title, to Engelberg Huller Company, Inc., 831 West Fayette Street, Syracuse 4, N. Y., attention John Simmons, Product Manager.

Optical Tooling in Industry

"Optical Tooling," the revolutionary new method of measuring, positioning, and aligning, is presented in a simple, concise manner by means of animated drawings and working models of optical instruments and tooling bars. The film covers the principles of optical tooling, illustrates some of its general applications, and shows its advantages over older mechanical methods.

In addition to explaining the basic theory of optical tooling, the film also illustrates specific industrial applications in research, design, and production. Automobile, airplane, and other models are used with setups of optical-tooling equipment to illustrate applications.

This optical-tooling system reduces production setup time by as much as 90 per cent and permits measurements with previously unobtainable accuracy.

The 35-min, 16-mm, optical sound track is available for free loan to industrial firms, engineering associations, and educational institutions. Requests for this film should be addressed to the Sales Planning Department, Charles Bruning Company, 4700 Montrose Avenue, Chicago 41, Ill.

Castings

An unusual 16-mm sound-color film showing "The Big Difference" between an ordinary casting or weldment and a modern engineered casting, is available for loan. The film reveals a new concept in foundry operations by tracing the development of an engineered casting.

How modern static and dynamic testing procedures are employed to determine the functional strength and weaknesses of an original part, in this case a weldment, are shown. These nondestructive test results aid engineers in designing a casting to replace the weldment. After extensive testing, the casting proves lighter, stronger, and less costly.

Valuable information for the designer and developer is presented in this film in an interesting, easily understood manner.

Loan copies of the film are available free; users pay only small return postage, by writing Superior Steel & Malleable Castings Company, Benton Harbor, Mich.

Reinforced Plastics

A new color slide film, "Designing With Reinforced Plastics," was developed by the Reinforced Plastics Division, The Society of the Plastics Industry, Inc., to bring to the attention of product designers and engineers, architects, and top business management the often unappreciated range of use of reinforced plastics. The film explores the physical and economic reasons for today's growing acceptance of these materials in aircraft, boating, automotive, railroad, home, and commercial building, industrial and appliance housings, sporting goods, and other fields.

The 74-frame color film and script, providing a 20-min program, can be purchased for $15 from the Public Relations Department, The Society of the Plastics Industry, Inc., 250 Park Avenue, New York 17, N. Y.

Automated Press

Clearing has just produced a 16-mm, color sound movie on an automated press line which produces automotive wheels. This film, "Transflex—Automation in Action," describes in detail the construction of the feed mechanism, the operation of the press line, and the significance of a new concept in press design—Transflex. The film runs for 22 min. To procure this movie for viewing, write Clearing Machine Corporation, c/o U. S. Industries, Inc., 6201 West 63rd St., Chicago 38, Ill.

Availability List

The Allegheny Ludlum Steel Corporation makes available a motion picture list which describes its more than 20 movies. The booklet lists all the company's motion pictures and gives a brief description of each as well as giving instructions on how to obtain prints for showing. General movies are available as well as technical movies on such subjects as the making of stainless steel and other products made by the company. Most of these films are in color, and all prints are 16 mm with sound. A copy of the booklet can be obtained by writing to the Advertising Department, Allegheny Ludlum Steel Corporation, 2020 Oliver Building, Pittsburgh 22, Pa.

D. W. Douglas Calls This Golden Age of Engineering

ENGINEERING has reached a "golden age" in which members of the profession are increasingly favored for top-management positions, Donald W. Douglas, president of the Douglas Aircraft Company, said.

"The very nature of modern industry makes this inevitable," said Mr. Douglas in an Engineering Week speech at the Hotel Statler, Los Angeles, Calif., where he received a special award for his contributions to aircraft and missiles engineering.

"The technological developments of recent years, many of which were spurred on by World War II, have had a profound impact on our whole industrial structure. More and more top management is forced to turn to the man with an engineering background."

The aircraft executive spoke at a banquet sponsored by the Los Angeles Council of Engineering Societies, comprising six professional engineering societies, of which The American Society of Mechanical Engineering is one, and the Technical Societies Council, made up of 18 separate societies.

In keeping with the week-long observance which the banquet highlighted, Mr. Douglas paid tribute to the engineer in the words:

"He is the agent through whom our expanding knowledge of the universe is transformed into something of tangible value to the people of the world. He is the middleman between pure science and a practical product, whether it be a great jet airplane or a more efficient garbage disposal unit. In this age of glory for the engineer, it is my hope that we do not wander too far from this down-to-earth concept of his function."

Mr. Douglas called for a careful appraisal of the balance between research and practical engineering in the nation's defense effort and posed the question:

"Is it possible that our government is overdoing the 'study contract' business and thereby helping create our much-publicized engineering manpower shortages?"

"I think this channeling of too much engineering talent in such directions has an adverse effect, for example, on our ability to design, produce, and develop quickly new and better aircraft. In our striving to find the ultimate weapon of tomorrow, we should not neglect the weapons of today. For that is when we may need them."

Mr. Douglas emphasized his belief in the importance of research as the means of acquiring "the basic knowledge upon which our engineering and production depend."

"My only concern," he added, "is that we keep the ratio in balance. And I think of late it has shown a tendency to swing somewhat out of balance."

A further aspect of such emphasis on study contracts, Mr. Douglas said, is the effect it has on individual careers.

"Too often," he stated, "young engineers yield to the lure of these specialized companies and neglect their long-range best interests. It is true that young men affiliating with such companies attain relatively high pay early in their careers. But what actually has happened is that they have reached a plateau rather quickly and then often have no further heights to scale. By comparison, the young man who goes to work for a large, fully integrated company engaged in actual production has increased his prospects immeasurably."

Research

Research Contracts

THE Office of Naval Research and the Air Research and Development Command have awarded fundamental research contracts to Horizons, Inc., the materials-research organization of Cleveland, Ohio.

Delay time in single crystals is the study to be conducted for the former agency in the Metallurgy Department. The latter study is of the ferromagnetic properties of the rare earths and will be directed in the chemistry department.

The single-crystal study was awarded to Horizons because of their long experience in this field and the previous work in growing and studying the properties of single crystals of metals and nonmetals.

Time delays, measured in microseconds, between the moment that force or stress is placed on the crystal and the moment of deformation will be studied because it is believed that an understanding of what causes the delay will throw light on the phenomenon of brittle fracture that certain metals display under certain conditions. Ductile failure as well as brittle failure will be studied.

Praseodymium, neodymium, dysprosium, and holmium will be the initial rare earths that will be examined in the second contract. The rare earths have exhibited peculiar magnetic properties, and it is thought that the substitution of the rare earths for some of the other metals may gain higher and better magnetic characteristics with small quantities of the rare earths. Resultant smaller circuits made of the rare earths would have more appropriate characteristics for such uses as high-speed computers, and the study could be especially useful in more clearly understanding and correlating electronic and atomic structures and other properties of the rare earths.

Industrial Products Research

IMPROVEMENT and diversification in the industrial use of cellulosic and synthetic fibers, have been the chief objectives of du Pont's $2,000,000 Industrial Products Research Laboratory in Newport, near Wilmington, Del. It has thus played a key role in the rapid expansion of industrial markets for man-made fibers. The laboratory has contributed much of the basic knowledge leading to the growing use of nylon tire cord and has developed technology for such potentially important products as papers and reinforced plastics made with synthetic fibers. See pages 406 and 407.

Completely equipped for broad-scale studies of industrial applications of man-made fibers, the laboratory has also been responsible for a wide range of contributions in fiber properties, methods of processing, and end product developments.

In addition to fully equipped physical testing facilities for fibers and industrial end products, the laboratory includes an operating area in which key steps in manufacture of industrial products can be duplicated. This equipment is used in investigating the role of du Pont fibers in such applications as tire cord, plastics reinforcement, nonwoven fabrics and felts, papers, bearings, coated protective coverings, filling materials, and mechanical rubber goods.

Du Pont's Textile Fibers Department, which manufacturers only the raw fibers—rayon, acetate, nylon, "Orlon" acrylic fiber, "Dacron" polyester fiber, and "Teflon" tetrafluoroethylene fiber—established the laboratory late in 1954. It serves as the second arm of the Textile and Industrial Products Research Division, carrying out major research functions in relationship with the department's merchandising and technical service organizations, fundamental research laboratories, and manufacturing plants.

These functions are:

1 To develop new end-use technologies meeting needs expressed by present and potential users of du Pont fibers.

2 Through creative research, to develop new concepts of fiber utilization for evaluation by industry.

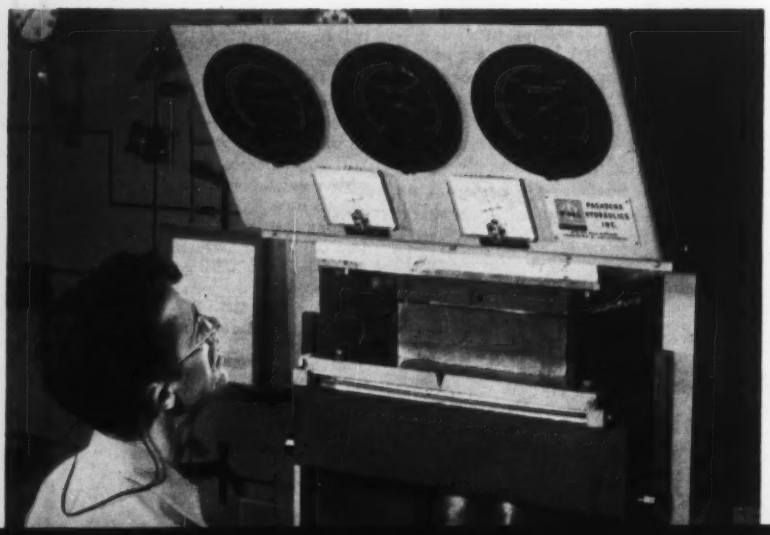
3 To evaluate new or modified fibers developed in du Pont's basic research laboratories from the aspect of applicability to present or potential industrial end uses.

4 To define objectives for basic research in meeting industrial needs for new or modified fibers.

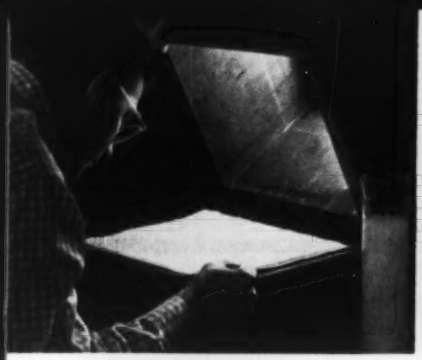
5 To evaluate modifications in existing fibers resulting from manufacturing improvements or changes in physical properties such as diameter, cross section, or tenacity.

Tire Plunger Test. An Instron tester, capable of exerting force of 10,000 lb, is used to determine carcass strength and record exact force required to push plunger through wall of fully inflated tire. An interesting feature is that the $1\frac{1}{4}$-in. plunger used for tires with conventional cord will not penetrate tires reinforced with nylon or new "Super Cordura" high-tenacity rayon yarn. A $\frac{7}{8}$-in. plunger has had to be adopted to punch through these high-performance tires. In the laboratory-operating areas, production equipment is available for every step of tire construction from basic fiber and rubber to finished tires. Equipment is part of facilities for study of processing methods and development of new industrial end products of man-made fibers at du Pont's $2 million Industrial Products Research Laboratory at Newport, near Wilmington, Del.

DU PONT'S INDUSTRIAL PRODUCTS RESEARCH

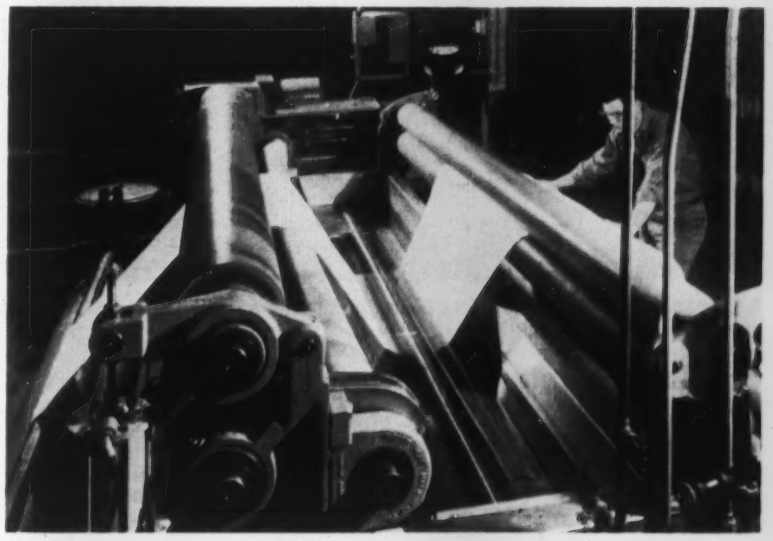


300-Ton Laminating Press. Press is used to cure synthetic-fiber-reinforced plastic laminate structures under controlled heat and pressure conditions in program aimed at improving properties of reinforced plastics through use of du Pont fibers.

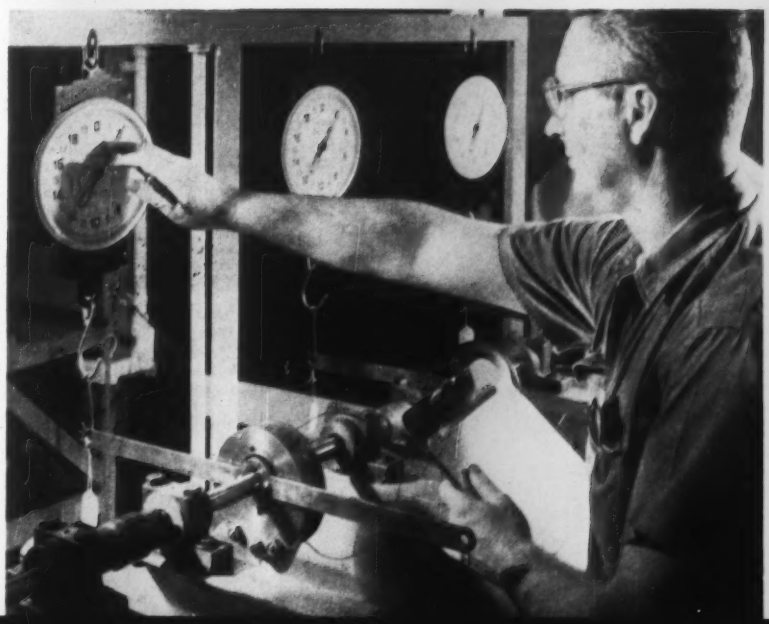


Synthetic-Fiber Paper. Slurry of dispersed synthetic fibers in water is filtered on wire screen to form a handsheet, *left*, first step in making experimental sheet of synthetic-fiber paper. Experimental handsheet of synthetic fibers, *center*, is passed between two pressure rolls to remove excess water prior to drying. The synthetic fiber is then pressed in hydraulic press at controlled temperature and pressure. Experimental handsheet, *right*, of synthetic fibers is dried by passing over a heated drum. Industrial end uses with considerable promise, include electrical insulation, backings for coated fabrics, map and chart paper, filtration, light-duty tarpaulins, replacement for multiwall bags, and feltlike structures for low and high-pressure laminate reinforcing batts. Many of these uses are now being field tested.

Synthetic-Fiber Felt. Shrinking by chemical action or heat is final step in production of nonwoven felt of synthetic fibers in du Pont process. Wide batt enters machine at *right*, emerges as narrower strip of felt at *left*. Density, hardness, and other properties of felt can be varied by controlled changes in processing. Largest initial field for synthetic-fiber felts has been filtration of gases and liquids—in chemical manufacture, food processing, and air cleaning—but a variety of mechanical uses is expected to develop, particularly in wicking, sealing, lubricating, cushioning, and polishing materials.



LABORATORY



Bearing Test Stand. Bearings faced with fabric of "Teflon" tetrafluoroethylene fiber and other synthetic fibers are tested under given loads at controlled speeds in studies aimed at development of new industrial end products of man-made fibers at du Pont.

ASME News

With Notes on Society Activities and Events

E. S. Newman, *News Editor*

View of San Francisco, Calif., the host city for the 1957 ASME Semi-Annual Meeting, June 9–13, at the Sheraton-Palace Hotel

1957 ASME Semi-Annual Meeting Program to Be Largest Ever

PRESENT planning for the 1957 Semi-Annual Meeting of The American Society of Mechanical Engineers to be held in San Francisco, Calif., indicates that the technical program will be the largest ever presented at an ASME Semi-Annual Meeting. More than 50 technical sessions are scheduled for presentation at the Sheraton-Palace Hotel. The American Rocket Society, an affiliate of ASME, will program sessions at the St. Francis Hotel.

Technical Program

The technical program will feature many papers on aviation and related subjects sponsored by the Aviation and Gas Turbine Power Divisions and the American Rocket Society. Rather than their usual annual conference,, the Aviation Division is participating extensively in the Semi-Annual Meeting. Among the other subjects to be presented will be nuclear power, fluid mechanics, lubrication in heat transfer, management, solar energy, lumber handling, and many others. A three-session symposium on Heat Transfer in Biotechnology, which has been arranged by the Heat Transfer Division, will offer a valuable opportunity for the discussion of engineering and physiological aspects of extremely important heat transfer problems. Nine interesting papers will be presented by some of the foremost authorities in the field.

The general program will include a joint Aviation-ARS Luncheon, Nuclear Engineering Luncheon, and general dinner in addition to the usual President's Luncheon, the banquet, and ARS Dinner. Numerous plant trips and sight seeing tours will be offered. An interesting women's program is also planned.

ASME Tours

Among the several options offered after the meeting is a two-day trip to Yosemite National Park or a fifteen-day trip to the Hawaiian Islands. There will be meetings to show colored slides of scenery and interesting "shots" which can be taken in the near vicinity of San Francisco, Yosemite National Park, and Carmel (Monterey Bay). These showings will be on a basis to interest those who are photographic enthusiasts. In addition, it is planned to show slides and scenic moving pic tures of interest to those who enjoy viewing scenery as contrasted to those who wish to take pictures. The fundamental aim of the Photographic Committee will be to assist these two groups in taking as many photographs and in seeing as much scenery as possible during a period which will also be filled with technical and social activities. For details on the Hawaiian trip, write to Mr. Ernest Hartford, ASME, 29 West 39th Street, New York 18, N. Y.

ASME Tour to Hawaii

Following San Francisco Semi-Annual Meeting

June 13 to 29—fifteen full days

United Airlines—San Francisco–Honolulu

Steamship Lurline—Honolulu–San Francisco

OUTER ISLAND TOUR for five days to

Kauai, Maui, Hawaii

Honolulu and Oahu—six days

Plant Visits including Pearl Harbor and sight-seeing to principal points of interest and of scenic beauty

Meeting with ASME Hawaiian Section and Woman's Auxiliary

Full details as to price and schedules, Royal Hawaiian Hotel and other first-class hotels on islands upon request to ASME Headquarters—29 West 39th Street

New York 18, N. Y.

ASME Survey Shows Industry Must Revamp Battle of Engineers Shortage

Survey results from questionnaire circulated during 1956 Annual Meeting

AMERICAN industry may have to revise its battle plans in the fight to relieve the current shortage of engineering talent. This is one conclusion drawn from the results of a survey published March 11, 1957, by The American Society of Mechanical Engineers.

The survey, conducted at the ASME Annual Meeting in New York, N. Y., last November and recently tabulated indicates that the majority of the engineers who answered think that industry should put more emphasis on increasing the productivity of engineers already employed. This would be in addition to continuing efforts to increase the number of students graduated by engineering colleges each year.

In response to the question, "What measures do you think should be taken to end the shortage of engineering manpower?" 65 per cent of the answers suggested changes in current industrial practices.

In the order of frequency these steps dealt with:

1 Providing engineers employed in industry with more technical assistants and clerical help, thereby freeing professional men for more creative work. (31 per cent)

2 Increasing salaries to make the profession more attractive to youngsters and to qualified engineers who have been lured to other fields by higher pay. (21 per cent)

3 Improving the recognition and prestige accorded to engineers for their contributions to the economy. (12.5 per cent)

Tabulations were based on a total of 880 men who said that they hold a degree in engineering. An additional 130 who attended the meeting and answered the questionnaire but did not claim an engineering degree were tabulated separately.

Dr. Ryan Comments

Commenting on the survey, William F. Ryan, ASME President, said, "It is apparent to me, from these results, that many efforts remain to be made by American industry before we can say we are doing all we can. The idea that engineers need more subprofessional assistance is a recurring one. So is the suggestion of higher salaries, despite the fact that starting incomes, at least, are at an all-time high for the profession. In my own opinion the most urgent salary problem is the compensation of teachers in engineering schools. Without competent teachers we shall have no engineers."

"Most fundamental perhaps, is the well-founded feeling that engineers and their contributions to our economy are not sufficiently appreciated. We live in the Age of Technology—the Age of the Engineer—but very few people know of the immense achievements of this professional group."

"It is probably fair to say that the bulk of industry's efforts resulting from this shortage have been aimed at recruiting more engineers for their own companies and in long-range efforts to encourage more men to enter the profession," Dr. Ryan continued. "Now it appears that we could use more efficiency in utilization of engineering talent right in our own engineering departments."

Answers to Questions

Fifteen per cent of the respondents suggested that the shortage could be alleviated by encouraging youngsters to enter the profession. An additional twenty per cent of the answers were classified under such headings as:

Improve high-school courses, 3 per cent; improve college courses, 3 per cent; give financial support to colleges, 1 per cent; and miscellaneous, 9 per cent.

Additional questions on the survey dealt with the adequacy of high-school and college education.

About 80 per cent said that the high schools which they had attended did a "good" or "superior" job in preparing them for an engineering education, while an additional 17 per cent said that their high schools were "fair," and 3 per cent said "poor." Following this, however, half of the engineers said that today's high schools are not doing as good a job as their own had done.

Engineering colleges fared somewhat better, with 90 per cent saying their alma maters did a good or superior job in preparing them for the profession of engineering, 9 per cent saying fair, and only 1 per cent saying poor.

Asked for their opinions as to whether the engineering colleges today are doing as good a job as their own had done, 31 per cent said today's are "better," 55 per cent said "as good," and

Left to right, **S. G. Guins, Cleveland; A. B. Heiberg, Akron; E. V. Jacobson, Pittsburgh; R. V. Reynolds, Westmoreland; and A. C. Pasini, Vice-President, ASME Region V, discuss the need for better means of communication between the Professional Divisions activities and the Section members at a Professional Interest Conference held by Region V in Akron, Ohio, Feb. 16, 1957. The Akron Standard Mold Company acted as host for the luncheon. Mr. Pasini was principal speaker at luncheon and his talk described ASME ideals and accomplishments.**

eight per cent said "not as good."

Tabulations according to the year in which the respondent graduated indicated that older men appeared to be slightly more critical of today's high schools and colleges than younger men. Suggestions on improving high schools' and colleges' preparation for engineering were classifiable into the following categories:

To Improve High Schools

Improve technical courses	56%
Improve nontechnical courses	10%
Enlist the support of industry	6%
Better vocational guidance	6%
Better teachers and facilities	5%
Special attention for superior students	2%
More pay for teachers	2%
Miscellaneous	13%

To Improve Colleges

Improve nontechnical courses	28%
Improve technical courses	24%
Extend the present four-year college program	13%
Enlist the support of industry	10%
Better teachers and facilities	5%
More applied courses	4%
More pay for teachers	2%
Improve vocational information	2%
Higher entrance requirements	2%
Miscellaneous	10%

* Including suggestions of a co-operative industry-college program.

ASME Tour

Puerto Rico and Virgin Islands

April 10 to 19, 1957

Following Birmingham Spring Meeting

via airplane to San Juan from Birmingham, Ala., *or* New York, N. Y.

Best Hotels—Fine Party of ASME members and their friends visiting San Juan, Mayaguez, and Ponce plus scenic trip in Puerto Rico and St. Thomas in Virgin Islands

Caribe-Hilton Hotel—San Juan

Virgini Isle Hotel—St. Thomas

Home by April 19 in time for Easter

Full details—schedules—Price on Request

ASME, 29 West 39th Street
New York 18, N. Y.

"Management Meets Competition" to Spark ASME-SAM Conference in New York

"Management Meets Competition" will be the theme of the twelfth annual Management Engineering Conference, sponsored jointly by the Society for Advancement of Management and the Management Division of The American Society of Mechanical Engineers, which will be held at the Hotel Statler, New York, N. Y., April 25–26, 1957.

In perpetuating the high standards which have been established over the years for this conference, the conference committee has made an extensive survey to bring to the conference the latest and best techniques of management engineering. All SAM Chapters and ASME Sections were requested to submit nominations of outstanding speakers in the various areas of the country, for consideration by the committee.

This session will emphasize practical approaches heavily illustrated with case histories detailing how many leading companies have reduced costs and improved profits.

Technical Program

On Thursday morning, April 25, the technical sessions will open in the Grand Ballroom and the Georgian Room. Harry M. Kaiser will deliver the Conference Keynote for SAM, in the Grand Ballroom, while Hugh A. Bogle will deliver the Conference Keynote for ASME in the Georgian Room.

The program includes 16 distinguished technical speakers who will discuss proved methods by which management can successfully meet competition through Operations Research, Work Measurement, Wage Incentives, Quality Control, Material Handling, Integrated Data Processing, Cost Reduction, and the Management of Industrial Engineering.

W. L. Batt Banquet Speaker

The dinner speaker on Thursday evening will be William L. Batt, past-president of S.K.F. Industries, and past-president of ASME. As Chief of the ECA Mission to Great Britain, 1950–1952, and Minister of Economics and Finance in the U.S. Delegation to NATO, in 1953, Mr. Batt is eminently qualified to speak on the subject "Good Management—A Requirement for Peace." The dinner speaker will be introduced by SAM National President John B. Joynt. Mr. Joynt will also present the SAM Annual Awards.

Supplementing the technical and inspirational content of the Conference will be its social aspects. In addition to the Cocktail Party, a Women's program has been planned under the direction of Mrs. Bruno Moski. The program will include two special luncheons, a fashion show, and a tour of the United Nations.

The Annual Management Engineering Conference has traditionally provided an occasion for the reunion of management executives and engineers from the entire country. Judging from the early registrations already received, the 1957 Conference should establish a 12-year attendance record.

Program for ASME Wood Industries Conference Announced

The application of automatic methods to the woodworking industry will be discussed at the 1957 Wood Industries Conference. The conference is the first held in several years by the Wood Industries Division of The American Society of Mechanical Engineers. The Division recently has devoted most of its program efforts to general society meetings.

Winston-Salem, being one of the largest furniture manufacturing centers in the world, offers an excellent forum for the conference. It is in this area that much of the pioneering of new automatic methods has been applied in furniture manufacture.

The two-day conference will feature a selection of plant visits as well as speakers from all parts of the nation. On the last afternoon a choice of three inspection trips is offered—The B. F. Huntley Furniture Company in Winston-Salem, The Stanley Furniture Company in Stanleytown, Va., or The American Furniture Company in Martinsville, Va. A banquet is planned for the first evening at

which ASME President William F. Ryan will speak on "The Professional Division."

The tentative program follows:

THURSDAY, MAY 16

8:00 a.m.

Registration

9:30 a.m.

Session 1—Automation in Woodworking

Chairman: *C. L. Babcock*, president, Babcock Machinery Co., Inc., Long Island City, N. Y.

Vice-Chairman: *W. K. Stamels*, treasurer, The Enterprise Co., Columbiana, Ohio

Selection of Carbide-Tipped Saw Blades for Optimum Performance, by *E. J. Dower* and *W. E. Oakley*, Southwest Research Institute, San Antonio, Texas

Automatic Machining in Furniture Manufacture, by *E. Sigurd Johnson*, North Carolina State College, Raleigh, N. C.

Automatic Sanding, by *L. G. Brown*, Curtis Machine Division, Carborundum Co., Jamestown, N. Y. (Paper No. 57—WDI-6)

12:15 p.m.

Luncheon

Presiding: *L. A. Patronsky*, Wabash Screen Door Co., Minneapolis, Minn.

Speaker: *Carl A. Rishell*, vice-president, Timber Engineering Co., Washington, D. C.

Subject: **Importance of Research in Furniture Making**

2:30 p.m.

Session 2—Controls in Woodworking

Chairman: *L. S. Inscoe*, tooling engineer, Drexel Furniture Co., Drexel, N. C.

Vice-Chairman: *T. D. Steinway*, Steinway and Sons, Long Island City, N. Y.

Woodworking Accuracy, by *Henry B. Pittman, Jr.*, quality-control engineer, Morgan Manufacturing Co., Black Mountain, N. C. (Paper No. 57—WDI-3)

Finishing Controls, by *N. Clark Hatcher, Jr.*, superintendent of finishing, Drexel Furniture Co., Drexel, N. C. (Paper No. 57—WDI-1)

7:00 p.m.

Banquet

Toastmaster: *T. C. Heyward, Jr.*, Firm of T. C. Heyward, Charlotte, N. C.

Introduction of Speaker: *James H. Sams*, Vice-President, Region IV, ASME

Speaker: *William F. Ryan*, President, ASME

Subject: **The Professional Division**

FRIDAY, MAY 17

8:00 a.m.

Registration

9:30 a.m.

Session 3—Symposium on Core Material for Plywood

Chairman: *W. Burdette Wilkins*, consulting engineer, Ridgewood, N. J.

Vice-Chairman: *Norman C. Bye*, Henry Disston Division, H. K. Porter Co., Philadelphia, Pa.

Standard Lumber Cores, by *C. D. Dosker* and *Sterling Durst*, Gamble Bros., Inc., Louisville, Ky.

Chipboard, The Superior Plywood Material, by *P. F. Brusquini*, Granite Board Division, National Starch Products, Inc., Coffstown, N. H. (Paper No. 57—WDI-5)

Paper Honeycomb Used for Core Materials, by *R. A. McKay*, Brunswick-Balke-Collender Co., Marion, Va. (Paper No. 57—WDI-4)

The Case for the Hollow Core, by *Ralph Casselman*, Washington Door Co., Washington, N. J. (Paper No. 57—WDI-7)

The Effect of Mechanization on Factory Cost in Plywood Manufacturing, by *G. W. Smith*, Roddis Plywood Corp., Marshfield, Wis. (Paper No. 57—WDI-2)

1:30 p.m.

Inspection Trips (choice of one)

B. F. Huntley Furniture Co., Winston-Salem,

or

Stanley Furniture Co., Stanleytown, Va.

American Furniture Co., Martinsville, Va.

OGP Division to Hold Diesel Engine Conference and Exhibit

The Oil and Gas Power Division of The American Society of Mechanical Engineers has built up what seems to be a very interesting Conference. This the twenty-ninth will be held May 20–23 at the Kentucky Hotel, Louisville, Ky.

They are meeting for four days during which time they will present eleven papers and have two panel discussions. There will also be a plant trip where a diesel-propelled boat will be used to take the party through the River Locks and other installations.

The Women's Program is planned to show the ladies some "Southern Hospitality" and should prove very interesting and pleasurable.

The technical program follows:

MONDAY, MAY 20

9:30 a.m.

Session 1

Chairman: *Ervin Dahlund*, ACF Industries, Albuquerque, N. Mex.

Vice-Chairman: *George Dashefsky*, New York Naval Shipyard, Brooklyn, N. Y.

Variations in Marine Engine Performance With Departures From Design Conditions of the Propeller, by *F. C. Vibrans, Jr.*, Fairbanks, Morse & Co., Beloit, Wis. (Paper No. 57—OGP-2)

Chromium Plating Development at the U. S. Naval Engineering Experiment Station, by *R. W. Reynolds*, U. S. Naval Engineering Experiment Station, Annapolis, Md.

2:00 p.m.

Session 2

Chairman: *A. C. Grammer*, Northern Division, Lake Tankers Corp., Hartford, Ill.

Vice-Chairman: *W. J. Fritton*

Sizing of Centrifugal Separators for Residual Fuels, by *Kurt Froehlich*, Nordberg Manufacturing Co., Milwaukee, Wis.

The Use of Heavy Fuels on River Towboats With High-Speed Diesel Engines, by *E. Renshaw*, St. Louis Shipbuilding & Steel Co., St. Louis, Mo.

8:00 p.m.

Special Lecture

Chairman: *Robert Cramer, Jr.*, Nordberg Manufacturing Co.

Vice-Chairman: *Brian Corrigan*, The Texas Co.

Residual Fuels for Diesel Engines, by *Lee Schneitter*, Ebasco Services Inc., New York, N. Y.

TUESDAY, MAY 21

9:30 a.m.

Session 3

Chairman: *W. C. Fischer*, Fairbanks Morse & Co., Beloit, Wis.

Vice-Chairman: *J. C. Gibb*, Socony-Mobil Oil Company, Inc., New York, N. Y.

Panel Discussion: Piston Rings for Oil and Gas Engines

Panel Members:

H. G. Braendel, Pederick Piston Ring Co., Philadelphia, Pa.

W. M. Kauffman, Worthington Corp., Buffalo, N. Y.

Fred Robbins, Koppers Division, Inc., Baltimore, Md.

Leo T. Brinson, Nordberg Manufacturing Co., Milwaukee, Wis.

C. J. Kremer, Jr., C. Lee Cook Co., Louisville, Ky.

WEDNESDAY, MAY 22

9:30 a.m.

Session 4

Chairman: *G. W. Ferguson*, The Texas Company, New York, N. Y.

Vice-Chairman: *O. H. Moore*, Tennessee Gas Transmission Co., Houston, Texas

A Practical Engine Scope for Field Maintenance, by *E. Eugene Echlund*, Allen B. DuMont, Inc., Clifton, N. J.

A Study of Industrial Engine Operation, by *H. E. Fisher*, Tennessee Gas Transmission Company, Houston, Texas, and *Vernon Miles*, field engineer, Sperry Gyroscope Co., Great Neck, L. I., N. Y. (Paper No. 57—OGP-3)

2:00 p.m.

Session 5

Chairman: *T. H. Pofahl*, El Paso Natural Gas Co., El Paso, Texas

Vice-Chairman: *George White*, Tennessee Gas Transmission Co., Houston, Texas

Panel Discussion: Engine Intake Air Conditioning

Panel Members:

R. E. Brown, Air-Maze Corp., Cleveland, Ohio

W. R. Brooks, Cooper-Bessemer Corp., Mt. Vernon, Ohio

D. M. MacMakin, The American Air Filter, Inc., Louisville, Ky.

Tracy Park, Tennessee Gas Transmission Co., Houston, Texas

THURSDAY, MAY 23

9:30 a.m.

Session 6

Chairman: *W. E. Warner*, Natural Gas Pipe Line Co. of America, Hooker, Okla.

Vice-Chairman: *Dwight MacMakin*, The American Air Filter, Inc., Louisville, Ky.

Effect of Intake-Combustion Air Conditioning on Performance of Spark-Ignition Gas Engines, by *W. F. MacInnes* and *R. L. Solnick*, Fluor Corporation, Los Angeles, Calif. (Paper No. 57—OGP-5)

Turbocharger Development for the Two-Cycle Engine, by *J. D. Hines* and *Nelson Reed*, Cooper-Bessemer Corporation, Mt. Vernon, Ohio (Paper No. 57—OGP-4)

2:00 p.m.

Session 7

Chairman: *W. K. Kauffman*, Worthington Corp., Buffalo, N. Y.

Vice-Chairman: *Ralph Ledbetter*, Burgess-Manning Co., Dallas, Texas

Gas Pulsation—The Problem, SGA's Approach and Results, by *E. N. Henderson*, Arkansas Louisiana Gas Company, Shreveport, La.

An Appraisal of Compressor Cylinder Cooling Requirements, by *W. F. May* and *A. G. Clark*, Ingersoll-Rand Co., Painted Post, N. Y. (Paper No. 57—OGP-1)

Order for Technical Papers

Only numbered ASME Papers in this program are available in separate copy form until Feb. 2, 1958. Copies can be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Prices are 25 cents to members of ASME, 50 cents each to nonmembers. Papers must be ordered by the paper numbers listed in this program, otherwise the order will be returned. The final listing of available technical papers will be found in the issue of Mechanical Engineering containing an account of the Conference.

Nation's Foremost Designers to Lead Discussions at Second ASME Design Engineering Conference

THIRTY-THREE speakers, drawn from the top levels of the nation's design engineers, will lead discussions at the second ASME Design Engineering Conference when it is held at the New York Coliseum in May.

The conference is being held in conjunction with the second Design Engineering show and will run for three days, May 20–22, while the show will run for four, May 20–23. The conference is sponsored by the Machine Design Division of The American Society of Mechanical Engineers and the show is produced by Clapp & Poliak, Inc., New York exposition management firm.

ASME President William F. Ryan, vice-president and senior consulting engineer, Stone & Webster Engineering Corporation, Boston, Mass., will deliver the principal address at a banquet at the Hotel Sheraton-Astor, on May 23.

Conference sessions will consider such problems as procedures in developing new designs, and the electrical, materials, and mechanical aspects of design engineering. Considerable emphasis will be placed on designing in relation to automation and automatic processes.

The show, one of the most phenomenal in the industrial exposition field, will be among the five largest annual industrial expositions of 1957, despite the fact that it was held for the first time only last year. It will be two and one-half times the size of the initial show, and has been virtually sold out for months.

Almost every major company in the United States will be represented among the visitors, and there will be visitors from at least a dozen foreign countries. Exhibits will show products which go into the making of other products. These include mechanical, electrical, hydraulic, and pneumatic components; metallic and nonmetallic materials; fasteners; finishes and coatings; shapes and forms, and accessories to product development.

MONDAY, MAY 20

10:00 a.m.

Procedures in Developing New Designs

A question-and-answer panel session with questions from the floor.

Chairman and Moderator: *George F. Nordenholt*, editor, *Product Engineering*, New York, N. Y.

Vice-Chairman: *Charles Markes*, member, New York and Patent Bar, New York, N. Y.

Panel Members: T. M. Butler, director of engineering, Burroughs Corp., Detroit, Mich.; M. S. Curtis, engineering vice-president, Warner & Swasey Co., Cleveland, Ohio; G. F. Habach, vice-president, engineering, Worthington Corp., Harrison, N. J.; R. H. Hose, partner, Henry Dreyfus Associates, New York, N. Y.; W. J. Russell, vice-president, engineering, Landers, Frary & Clark, New Britain, Conn.; and W. D. Teague, Walter Dorwin Teague Associates, New York, N. Y.

TUESDAY, MAY 21

9:30 a.m.

Mechanical Session

Chairman: *Colin Carmichael*, editor, *Machine Design*, Cleveland, Ohio.

Vice-Chairman: *Robert M. Conklin*, assistant manager, mechanical engineering department, Battelle Memorial Institute, Columbus, Ohio.

New Developments in Design and Application of Gearing, by *D. W. Dudley*, General Electric Co., West Lynn, Mass.

New Developments in Design and Application of Cams, by *H. A. Rothbart*, College of City of New York, New York.

Materials Session

Chairman: *Henry R. Clauser*, editor, *Materials & Methods*, New York, N. Y.

Vice-chairman: *Joseph Bonanno*, chief engineer, Lionel Corp., Irvington, N. J.

Metallic Materials, by *C. R. Simcoe*, Battelle Memorial Institute, Columbus, Ohio.

Ceramics and Refractory Materials, by *J. H. Koenig*, and *Edward J. Smoke*, Rutgers University, New Brunswick, N. J.

WEDNESDAY, MAY 22

9:30 a.m.

Mechanical Session

Chairman: *Harold Sizer*, director of design for machine tools, Brown & Sharpe Manufacturing Co., Providence, R. I.

Vice-chairman: *William C. Allen*, director, manufacturing and equipment engineering, Westinghouse Electric Co., Pittsburgh, Pa.

Designing for Easier Machining, Handling, and Assembly, by *K. O. Tech*, Cross Co., Detroit, Mich.

Hopper Feeding, by *F. E. Smith*, Perry Equipment & Engineering Co., Erie, Pa.

Materials Session

Chairman: *Carl Massopust*, director of research and development, plastics division, General American Transportation Corp., Chicago, Ill.

Vice-chairman: *Donald R. Meserve*, products manager, organic coatings, Metal & Thermit Corp., New York, N. Y.

Plastics and Rubbers, by *Wyman Goss*, General Electric Co., Pittsfield, Mass.

Coatings and Finishes, by *H. J. Reindl*, Inland Manufacturing division, General Motors Corp., Detroit, Mich.

Miss Selig Completes 50 Years at ASME—Turns "Temporary" Job Into a Career

ON APRIL 11, 1957, Miss Frances Selig will have been a member of the ASME Secretary's Staff for fifty years. About a week before the dramatic dedication ceremonies of the Engineering Societies Building in New York City, she had been engaged on a temporary basis to assist Miss Marian Parker, then secretary to Calvin W. Rice, who had taken over the Secretaryship of ASME at the 1906 Annual Meeting. After fifty years Miss Selig appears to have established something of a record for "temporary" employment.

Miss Selig Sees ASME Grow

Miss Selig joined the Secretary's Staff when a reawakening of the spirit which had animated the Founders was getting under way. As of Jan. 1, 1907, ASME membership numbered 3832. The Society had passed through the period of adolescence in which the officers and a few committees administered its affairs, and attention was primarily directed toward meetings (two a year), publications, and a Library. A Constitution and By-Laws, to take the place of the Rules written in 1880 and amended only slightly since then, had been adopted. Provision was made for numerous standing committees, for new committees, such as research, for Student Branches, and for what have since become Local Sections and Professional Divisons. Activities in standardization and test codes were on the increase. The Society was becoming truly national in character. Opportunities were being afforded for groups having specialized interests to organize and provide services to members.

New Building

Andrew Carnegie's gift of the Engineering Societies Building in New York had solved the problem of inadequate headquarters, library, and meeting space in the Society's house at 12 West 31st Street. For the first time it had brought under one roof and in close working partnership the great national engineering societies and their libraries. Enthusiasm, vision, and imagination were equal to the task of devising new fields of service and of better serving the old. Decision to increase income rather than to curtail services which modest dues could support had led to plans to develop publications and solicit advertising. Hundreds of younger men were pouring their talents and their zeal into Society activities.

Joins Editorial Department

It was into this atmosphere of re-

awakening and the planning of great projects that Miss Selig entered in 1907. When Lester G. French became Editor of the Society in 1908, she was transferred at his request to the Editorial Department. Under Mr. French's training she became competent in proofreading and editorial work in connection with Transactions and the Year Book, now known as the Membership List. Here she was engaged also in the work on national meetings of the Society and in the maintenance of membership records. For about a year her services were loaned to the Society's first advertising manager, E. J. Gibling, to assist in the establishment of that new venture.

Secretary to the Secretary

In 1920, when C. E. Davies, now Secretary of the Society, joined the ASME Staff, Miss Selig began working directly with him on meetings and publications. When he became Executive Secretary in 1932, she was transferred with him to the Secretary's office, where she soon acquired that special and intimate knowledge of the activities of the Council, the Secretary, and numerous committees that have placed her at the nerve center of the Society's life.

Gifted with an alert and orderly mind, an excellent memory, a passion for accuracy, and a marked talent for efficient and meticulous pains in performing her numerous duties, Miss Selig has discovered, and adapted herself to the idiosyncrasies of hundreds of Society officers and committeemen, and their counterparts in other institutions. Polite, gracious, and helpful, modest and retiring by habit and nature, she quickly learns to distinguish between pretense and honest worth in others, whether they are those with whom or for whom she works.

Congratulations, Miss Selig

To a colleague who has been closely associated with at least forty years of Miss Selig's half century of loyal service, she represents that solid core of accomplishment and dedication to be found at the heart of institutions that have been able to maintain, in bad times as well as good, the essential objectives that dictated their origins. In her he has come to admire an intense loyalty, patience with problems which arise, in the same or altered guise, year after year, and a kindly understanding of the peculiarities of her associates. Few ASME members will ever know how much they owe to her constant devotion to their interests.—G. A. Stetson, Editor Emeritus.

Miss Frances Selig, secretary to ASME Secretary C. E. Davies, who completes 50 years in the employ of the Society on April 11, 1957, smilingly reviews some of the events of her "temporary" job

ASME Coming Events

April 7–10
ASME Spring Meeting, Hotel Dinkler-Tutwiler, Birmingham, Ala.

April 8–10
ASME Instruments and Regulators Conference, Northwestern University, Chicago, Ill.

April 25–26
ASME Railroad Conference, Hotel Sheraton Chicago, Ill.

April 25–26
ASME-SAM Management Conference, Hotel Statler, New York, N. Y.

May 1–3
ASME Boiler and Pressure Vessel Committee out-of-town meeting, Rice Hotel, Houston, Texas

May 16–17
ASME Wood Industries Conference, Winston-Salem, N. C.

May 19–23
ASME Oil & Gas Power Conference, Kentucky Hotel, Louisville, Ky.

May 20–23
ASME Design Engineering Conference, Coliseum, New York, N. Y.

June 9–13
ASME Semi-Annual Meeting, Sheraton-Palace Hotel, San Francisco, Calif.

June 13–15
ASME Applied Mechanics Conference, University of California, Berkeley, Calif.

August 11–15
ASME Heat Transfer Conference, Pennsylvania State University, University Park, Pa.

Sept. 22–25
ASME Petroleum Mechanical-Engineering Conference, Hotel Mayo, Tulsa, Okla.

Sept. 23–25
ASME Fall Meeting, Hotel Statler, Hartford, Conn.

Oct. 7–9
ASLE-ASME Lubrication Conference, concurrently with ASME-IMechE International Conference on Lubrication and Wear, Royal York Hotel, Toronto, Ont., Canada

Oct. 8–12
ASME-AIME Fuels Conference, Chateau Frontenac, Quebec, Que., Can.

Dec. 1–6
ASME Annual Meeting, Hotel Statler, New York, N. Y.

(For Meetings of Other Societies, see page 403)

Junior Forum

Conducted for the National Junior Committee

By H. N. Weinberg,[1] Assoc. Mem. ASME

Young Mechanical Engineer in Teaching

By Richard P. Van Benschoten[2]

As an instructor in the mechanical-engineering department of Rutgers University, the State University of New Jersey, I am often asked why I remain in the teaching profession with the lucrative opportunities currently available to engineers in other fields of endeavor. Of course, I remain a teacher by choice, that choice based upon comparison of roughly equivalent periods spent in both industry and teaching.

In the spring of 1952 I, like other recent engineering graduates, found myself in the position of having my services sought by a wide variety of prospective employers. With no previous industrial experience and, at that time, no specific job preference, other than a desire for a challenging and diversified position, the problem of selecting a particular company was a difficult one.

For salary reasons, and because of the apparent opportunity for varied assignments, I accepted a position in the research and development branch of a major oil company. My assignments during the following two-year period included cost estimating, cost analysis, and materials and equipment testing and evaluation. Although I enjoyed and profited by this experience, I realized that I had not acquired that feeling which I believed essential to real success, the earnest love of my work. Furthermore, I did not conceive of myself developing this attitude in the foreseeable future in this field. For this reason, because of a desire to further my education, and to fulfill a long-suppressed desire to go into the teaching field, I decided to leave industry. In the summer of 1954 I accepted my present position.

Teaching Scope

Rutgers University, the State University, is composed of the Colleges of Engineering, Agriculture, Arts and Sciences, Schools of Law, Business Administration, and others too numerous to mention in this article. The College of Engineering, located in New Brunswick, has a total current student enrollment of approximately 650, offering BS degrees in mechanical, agricultural, electrical, civil, ceramic, sanitary, industrial, and planning engineering; MS degrees in most of these fields, and PhD degrees in ceramics and electrical engineering. The engineering faculty numbers 73, divided approximately in the ratio of two to one between the teaching and research groups. Some of the current research projects include:

(*a*) *Study of the Fine Structure of Metals by X-Ray Diffraction Methods:* To find the correlation of fine-structure with strength properties of metals.

(*b*) *Radiation Damage:* Investigation of crystal imperfection induced by neutron bombardment by x-ray diffraction methods and x-ray microscopy.

(*c*) *Communication Theory and Applications:* To investigate methods for improving the transmission and reception of voice and data.

(*d*) *Determination of Dynamic Soil Characteristics: To determine the dynamic characteristics of soils.*

Richard P. Van Benschoten

(*e*) *Ceramic Radomes:* To develop a radome capable of withstanding rain erosion, thermal shock, and so on, for high-speed missile and also capable of transmitting a radar signal with minimum attenuation and bending.

Research Opportunities

While current opportunities for research are good, future prospects appear to be even better. Due to the growing importance of scientific development in our society, industrial concerns are constantly increasing their efforts to encourage research in the colleges and universities throughout the country; this encouragement taking the form of the required funds and facilities. The bulk of research and development grants, of course, is provided by the Federal Government.

Keeping pace with the rapid advances in the scientific and technical fields requires a continual effort by the University. For instance, plans are under way for the establishment of a Nuclear Science Center at Rutgers University. The function of the Center, in conducting basic research, would be to provide an opportunity for original contribution as well as to assimilate information pertinent to specific engineering applications.

Curriculums to Fit Changing Times

On a smaller but equally important scale, individual courses and curriculums are being revised continuously to incorporate late developments in the various fields of engineering. At the present time, for instance, plans are being made to incorporate instruction in basic nuclear science as well as fundamental analog and digital computer techniques into undergraduate and graduate curriculums.

Changes such as these are often taken for granted, but they come about only through the continual efforts of an alert and aggressive faculty. I have found my teaching associates to be an extremely competent group. Their dedication to teaching or allied research is remarkable. This, of necessity, must be true in view of the limited financial incentives inherent in the profession. Many staff members devote all their time to research activities while others combine teaching and research to a varying degree. Many of the more experienced engage in consulting and writing in addition to their regular activities.

Thus far, in my two and one-half years at the University, I have confined my activities primarily to teaching and studying in order to fulfill requirements

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[2] Instructor in Mechanical Engineering, Rutgers, The State University, New Brunswick, N. J.

for an MS degree in mechanical engineering. I have taught courses in thermodynamics, machine elements, statics and dynamics, and supervised several of the mechanical-engineering laboratories. Fulfillment of requirements for my advanced degree is essentially complete. More than anything, I have learned that in any subject, success as a teacher requires far greater proficiency than that required for success as a student. A broad and thorough knowledge of the subject is essential to adequately answer the searching questions of the students.

Classroom Preparation

Although a normal teaching load ranges from 14 to 18 contact hours per week, preparation of lectures, grading of papers and reports, faculty-committee assignments, and student activities easily double or triple this figure. As a matter of fact, it is my observation that the college-faculty member who does not put in a normal work week, by industry standards, is the exception. However, the opportunity to adjust this work load in accordance with mood and other demands on one's time is a more than compensating factor. This flexibility in schedule and general lack of specific routine provides an independence in teaching which, of course, is not possible in industry.

Personal Satisfaction

I think my own greatest satisfaction comes from actual class contact with students. The new faces, new courses, and University atmosphere, in general, preclude the possibility of ever becoming bored. In dealing continuously with young people, interesting, worth-while, and amusing occurrences are endless. Also, there is the priceless inner pleasure which all teachers receive from being able to transfer to others that knowledge which they themselves may possess.

One of the major advantages which teaching has to offer is the frequency and length of breaks in its regular routine, including, of course, the summer recess.

Summer Employment

These breaks make it possible to spend brief periods in industry, to do extensive traveling, to write, or just to relax. It has been my experience, that upon resumption of teaching duties after such periods, I return to the classroom with renewed enthusiasm. In connection with summer employment, an increasing number of companies have organized summer programs. These provide a mutual exchange of knowledge and good will as well as a financial prop to those who avail themselves of these opportunities.

Salaries

A discussion of my teaching experience would be incomplete without a mention of salary. It is a generally accepted fact that all teaching salaries are low. In fact, results of a recent survey indicate that salaries of engineers in teaching are among the lowest of any profession. This has been a major contributing factor to the current shortage of teachers on all levels. However, a growing public awareness of the crisis ahead in American education may help to remedy this situation.

In summary, I feel that one of the major advantages of the teaching profession, especially to the recent graduate, is the opportunity to work in a variety of fields while continuing his education. I have found that my association with the faculty and students, and the satisfaction I realize from teaching more than compensate for the few disadvantages.

ASME Codes and Standards Workshop

1957 Edition of Nuclear Glossary Published

A NEW edition of "A Glossary of Terms in Nuclear Science and Technology" has just been published, and is now available from the ASME Order Department, 29 West 39th Street, New York, N. Y.

The new edition contains numerous corrections to the previous 1955 edition, as well as amplification and clarification of many definitions.

The Glossary consolidates some 1500 terms and definitions in the field of nuclear science and engineering into one alphabetical listing. Areas included are physics, reactor theory, reactor engineering, chemistry, chemical engineering, biophysics, radiobiology, instrumentation, isotopes separation, and metallurgy. It was originally prepared by committees supervised by the National Research Council, to co-ordinate the work done by the ASME's Nuclear Glossary Committee with that done by other societies. From 1950 to 1953, separate sections for nine areas were published by the Society. Until 1955, the sections were available in a plastic binder. In 1955 the definitions were put into a single alphabetical sequence, some editorial inconsistencies eliminated, and published. This 1957 edition is a corrected and clarified version of the 1955 edition.

The Glossary was submitted to the American Standards Association for approval as American Standard on July 20, 1956, by the National Research Council, and on Jan. 23, 1957, by the Society. Pending approval by ASA, the Glossary is being published as ASME Standard 110. Price is $5, with 20 per cent discount to ASME members.

Fastener Standards Reaffirmed

Two fastener standards have been reaffirmed by Sectional Committee B18 recently, and approval by ASA is expected shortly. They are:

Large Rivets (ASA B18.4-1950)
High-Strength High-Temperature Internal Wrenching Bolts (ASA B18.8-1950)

A. C. Millard

Word has reached ASME that A. C. Millard, an active member of many fastener standardization committees sponsored by the Society, has died.

Mr. Millard has been a member of Sectional Committee B1, Screw Threads, from 1948 to 1955, and served it as assistant secretary, and was a member of Sectional Committee B18, Nuts, Bolts, Rivets, and Similar Fasteners, for the same length of time.

He was also a member of B1 subcommittees on gages and gaging, and on minor diameter tolerances, and B18 subcommittees on wrench head bolts and nuts, slotted and recessed-head screws, tubular and split rivets, tapping screw threads, and sockets and wrench dimensions. He was an alternate member of Sectional Committee B27, Plain and Lock Washers, a member of B27 subcommittee on spring washers, and a member of Y14 subcommittee on drafting practice for screw threads.

K. D. Williams

Karl D. Williams, member emeritus on Sectional Committee B1, Screw Threads, and former representative of the U. S. Navy Bureau of Ships on many standards committees, has passed away.

Mr. Williams was a member of Sectional Committees A13, Scheme for Identification of Piping Systems; B1, Unification and Standardization of Screw Threads; B2, Pipe Threads; B5, Machine Tools and Machine Tool Elements; and B32, Wire Diameters and Sheet Metal Thickness.

He had been a member of numerous subcommittees under B1 and B18 prior to his retirement in 1949.

Z. R. Bliss Appointed Brown University Dean

Z. R. Bliss, Mem. ASME, executive officer of the Engineering Division of Brown University, has been appointed dean of the university. As dean, Professor Bliss will assist the president in the general administration of the university, and co-ordinate the three branches of the university.

Professor Bliss joined Brown University in 1923. He has been chairman of Sectional Committee B4, Preferred Cylindrical Limits, Fits, and Tolerances, since 1950, and was elected in 1956 to a five-year term on the ASME Standardization Committee.

C. A. Adams Receives Edison Medal

Comfort A. Adams, Mem. ASME, Honorary Member of the ASME Boiler and Pressure Vessel Committee, for many years chairman of the American Engineering Standards Committee (the predecessor of ASA), was awarded the Edison Medal of the American Institute of Electrical Engineers on January 21.

An accompanying certificate cited Dr. Adams for his "pioneering achievements in the development of alternating current, electric machines, and in electric welding; for vision and initiative in the formation of engineering standards organizations, and for eminence as an educator and consulting engineer."

The American Welding Society has announced that its Fifth Annual Welding Show, to be held in Philadelphia, Pa., April 9-11, will be called "The Adams Welding Show." He was one of the founders of AWS.

John A. Dickinson Receives Honorary Degree

Stevens Institute of Technology awarded the honorary degree of mechanical engineer to John A. Dickinson, Chief, Codes and Specifications Section, National Bureau of Standards, on February 1.

Mr. Dickinson represents the Bureau of Sectional Committees A17, Safety Code for Elevators, Escalators, and Dumbwaiters (of which he is Secretary Emeritus); B20, Safety Code for Conveyers; B15, Safety Code for Mechanical Power Transmission Apparatus; B30, Safety Code for Cranes, Derricks, and Hoists; A90, Safety Code for Manlifts (of which he is chairman); and A113, Safety Code for Parking Garage Equipment. He is also a member of the ASME Research Code on Elevators, and a member of numerous subcommittees of the afore-mentioned sectional committees.

Boiler and Pressure Vessel Committee Out-of-Town Meeting

A meeting of the Boiler and Pressure Vessel Committee of The American Society of Mechanical Engineers will be held on May 1 to 3 inclusive at the Rice Hotel, Houston, Texas.

The meeting will include a panel session on all the various Sections of the ASME Boiler and Pressure Vessel Code, which will include in part, power boilers, heating boilers, unfired pressure vessels, and welding requirements. Meetings of the various subcommittees are also planned. Four discussions in the field of nuclear energy are scheduled.

The all-day session of the Boiler and Pressure Vessel Committee is planned for Friday, May 3. Meetings of the various subcommittees as well as the Boiler and Pressure Vessel Committee are open to the public. The Committee holds six meetings a year, one of which is held out of New York City.

Representatives from both the Boiler and Pressure Vessel Committee and Region VIII-South Texas comprise the Planning Committee.

William H. Boehm

Word was received of the death on Jan. 24, 1957, of William Henry Boehm, Mem. ASME, Honorary Member of the Boiler and Pressure Vessel Committee.

Mr. Boehm was the only surviving member of the original pioneering Boiler Code Committee formulated in 1911. He was a member of the Society since 1901 and gave a half century of service to the public and the mechanical-engineering profession in fulfilling safety objectives for boilers and pressure vessels.

During his career he had served as dean of engineering at Clemson College and vice-president of Fidelity and Casualty Company in charge of Boiler and Machinery Insurance, and was the author of books and articles on steam-boiler explosions and power-machinery accidents. He was one of the founders and first secretary and treasurer of the Boiler and Machinery Insurance Rating Bureau.

The members of the Boiler and Pressure Vessel Committee at their recent meeting acknowledged by resolution Mr. Boehm's many contributions to engineering, and expressed their deep sorrow at his passing.

Irving E. Moultrop

Irving Edwin Moultrop, Hon. Mem. ASME, died at his home in Belmont, Mass., Feb. 24, 1957. He was Honorary Member of the Boiler and Pressure Vessel Committee since 1943 and served as a member on this Committee since 1915.

Mr. Moultrop had been a member of ASME for 55 years and had served as Manager and as Vice-President. He had done valuable work on Committees of the ASME dealing with the Power Test Code and Boiler and Pressure Vessel Code, and had been associated both here and abroad with activities of the International Electro-Technical Commission, and with World Power Conferences. He was awarded the Elliot Cresson Gold Medal of The Franklin Institute; the Engineering Societies of New England had presented him with the New England Award of that organization.

The members of the Boiler and Pressure Vessel Committee at their recent meeting, acknowledged by resolution Mr. Moultrop's many contributions to engineering and expressed their deep sorrow at his passing.

ASME Maintenance and Plant Engineering Group Holds First Meeting

The first meeting of the newly formed Maintenance and Plant Engineering Group of The American Society of Mechanical Engineers, officially recognized by the Council on March 1, 1957, was held in the Engineering Societies Building, New York, N. Y., on March 4, 1957.

The Maintenance and Plant Engineering Group is established to afford mechanical engineers engaged in this field a means for the discussion and solution of their many and varied problems.

At a meeting of the recently formed ASME Maintenance and Plant Engineering Group, *left to right,* are: Maurice Olchoff, Solar Aircraft Company, Des Moines, Iowa; K. P. Powers, Gulf Oil Corporation, Pittsburgh, Pa.; Guerard Mackey, chairman of the Group, E. I. du Pont de Nemours & Company, Inc., Wilmington, Del.; T. M. Shea, *standing,* Merck, Sharp & Dohme, Philadelphia, Pa.; R. H. Moore, Philadelphia (Pa.) Electric Company; J. R. Aikins, Gulf Research & Development Company, Pittsburgh, Pa.; and B. G. Evans, Eli Lilly & Company, Indianapolis, Ind

The Group is co-sponsoring papers at the 1957 ASME Semi-Annual Meeting, June 9-13, to be held at the Sheraton-Palace Hotel, San Francisco, Calif., and also is planning to sponsor a session at the 1957 ASME Annual Meeting.

Any member of the Society interested in this activity is urged to communicate with Guerard Mackey, Engineering Department, E. I. du Pont de Nemours & Company, Inc., Wilmington 98, Del. Further, interested members may register with the group by filling in the form on page 424 of this issue.

Actions of ASME Executive Committee

At a Meeting at Headquarters, March 1, 1957

A MEETING of the Executive Committee of the Council of The American Society of Mechanical Engineers was held in the rooms of the Society, New York, N. Y., on March 1, 1957. There were present: William F. Ryan, chairman; C. E. Crede, A. C. Pasini, V. W. Smith, of the Committee; J. O. Amstuz, chairman, Finance Committee; G. M. Muschamp, chairman, Organization Committee; J. L. Kopf, treasurer; E. J. Kates, assistant treasurer; Joseph Pope, director; D. W. R. Morgan, E. G. Bailey, past-presidents; C. E. Davies, secretary, O. B. Schier, 2nd, deputy secretary, D. C. A. Bosworth, T. A. Marshall, Jr., assistant secretaries; and Ernest Hartford, consultant.

The following actions are of general interest:

Formation of Maintenance and Plant Engineering Professional Group. Upon recommendation of the Board on Technology, at its meeting on Feb. 7, 1957, the Executive Committee of the Council voted to authorize the formation of the Maintenance and Plant Engineering Professional Group, with the following personnel to make up its executive committee: Guerard Mackey, chairman, R. H. Moore, secretary; J. K. Bryan, B. G. Evans, and A. W. Weber. The scope of activity will cover the following: (*a*) Managerial or control aspects covering such items as organization, planning, scheduling, work-order systems, maintenance-history records; (*b*) mechanical analysis of maintenance problems including development and use of instruments for diagnosing maintenance problems, diagnosing techniques and methods, and corrective action; and (*c*) design modification of equipment and facilities to reduce or eliminate maintenance problems.

1958 Technology Executives Conference. The Board on Technology, at its meeting on Feb. 7, 1957, voted to hold its 1958 Technology Executives Conference at Arden House, Harriman Campus of Columbia University, Harriman, N. Y., Jan. 5-7, 1958.

ASME-ARS Joint Committee. Upon recommendation of the ASME-ARS Joint Committee, concurred in by the Board on Technology, Feb. 7, 1957, the Executive Committee of the Council voted that, on a trial basis for one year, American Rocket Society be represented by a member of its governing body who will be a member ex-officio of the ASME Board on Technology, and who will have the privilege of sitting with the ASME Council, without vote, at meetings of the Council, except in executive session. Further, it was voted, that a member of the ASME Council will be a member ex-officio of the Executive Committee and Board of the American Rocket Society.

Furthermore, it was voted that an agreement be prepared whereby a member of one of the two societies may become a member of the other without payment of initiation or entrance fee in the second society; in each case, the member of the first society must present his application for membership in the second society and meet the membership requirements of the second society.

Student Participation in Mexico and Southern California Sections. Upon recommendation of the Vice-Presidents on Feb. 23-24, 1957, it was voted to modify the Council action of Nov. 13-14, 1955, regarding student participation in Mexico and Southern California Section to read as follows:

"That the Mexico Section and the Southern California Section encourage active participation in their respective Sections by engineering students enrolled at the University of Mexico and the University of California at Los Angeles, and that these students be permitted to subscribe to MECHANICAL ENGINEERING for twelve issues at the current rate of Student Member dues ($5 per year) and that such subscription be verified (or endorsed) as special Student subscriptions by the respective chairmen of the Regional Student Section Committees."

Recruiting Practices at Society Meetings. At its meeting on Jan. 4, 1957, the Executive Committee authorized the President to appoint a committee to develop a Society policy regarding recruitment procedures of companies during and in connection with ASME Meetings. The President has appointed the following to serve on the committee: D. W. R. Morgan, chairman; H. C. R. Carlson, and Glenn B. Warren.

Certificates of Award. Certificates of Award were granted to the following retiring chairmen of Sections: E. S. Williams, Chattanooga; C. Gentry Miles, North Alabama Subsection of Birmingham Section; J. R. Aikins, Pittsburgh; T. Randall DuBois, St. Louis; and Henry J. McCabe, Waterbury.

ASME Motion Picture. The Secretary

reported as follows on the distribution to date of "To Enrich Mankind," ASME Motion Picture, to bring the report up to date: Number of television bookings, 66; estimated television audience, 6,065,766; number of group bookings, 386; number of times shown to groups, 950; total audience of groups, 47,925.

This report covers only prints distributed through ASME headquarters and does not take into account the prints in the hands of Vice-Presidents in each Region nor the prints which have been purchased by industry. Nine prints have been sold to industry since the last report.

William Jordan Sweetser Fund. The register of Court of Probate, Penobscot, Maine, has advised the Society that in the will of Elizabeth M. Sweetser (widow of an ASME member), the net proceeds and net income from the sale of Mrs. Sweetser's homestead property in Orono, Me., is to be given to ASME. The sum of money is to be used for a fund to be known as the William Jordan Sweetser Fund and to be added to, and become a part of the Students Loan, preferably for the benefit of fatherless students.

New Engineering Center. The Secretary reported that the first important problem facing UET was to determine the feasibility of developing the present building site on West 39th Street in co-operation with The Engineers' Club which faces 40th Street. Two proposals were submitted by the architects, Shreve, Lamb & Harmon Associates, the cost estimates on which revealed that expenditures for rehabilitation would be so high as to make the use of the present site unwise. The trustees, therefore, decided to abandon plans for the present site and to seek a new one. Active steps are under way to that end.

The Secretary reported a communication, dated March 1, 1957, from W. J. Barrett, President of United Engineering Trustees, Inc., directed to the five societies concerned, advising of the impracticability of using the present headquarters. Further, that "the group of industrialists and educators headed by Dr. Kelly is perfecting its plans for the raising of funds from industry and expects to launch its drive in the spring." It was suggested that each society designate an individual or small committee to meet as a group with the Building Co-ordinator and develop a definite program for action by the Board of Trustees, at its meeting on March 28, 1957. The following were designated to serve as the ASME Group: E. G. Bailey, J. W. Barker, and D. W. R. Morgan.

The Engineering Institute of Canada. The revised agreement between The American Society of Mechanical Engineers and The Engineering Institute of Canada has been approved.

Charles F. Kettering Board of Award. Suitable appeals for individual contributions to the Charles F. Kettering Award Fund have been authorized for publication in MECHANICAL ENGINEERING. J. W. Barker was appointed to serve for one year as ASME representative on the Charles F. Kettering Board of Award; E. G. Bailey, three years.

Japan Society of Automatic Control. David M. Boyd, Mem. ASME, and active in the IRD, has been designated Honorary Vice-President to represent the ASME at the tenth anniversary celebration of the Japan Society of Automatic Control and Mr. Boyd to extend best wishes and congratulations to the society. Mr. Boyd has been invited to be one of the guest speakers.

Death Reported. The Executive Committee noted with deep regret the death of I. E. Moultrop, Feb. 24, 1957; manager of the Society, 1908–1911, and Vice-President, 1912–1914.

Presidential Representatives. William H. Pletta at the American Society of Heating and Air Conditioning Engineers annual meeting, Chicago, Ill., Feb. 27, 1957.

James H. Harlow and W. E. Belcher, Jr., at the American Academy of Political and Social Science annual meeting, Philadelphia, Pa., April 5–6, 1957.

K. M. Irwin has been designated Honorary Vice-President to represent the Society at the Sectional Meeting of the World Power Conference to be held in Belgrade, Yugoslavia, June 5–11, 1957. Mr. Irwin is heading the delegation of the U. S. Committee of World Power Conference.

Engineering Societies Personnel Service, Inc. (Agency)

THESE items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or nonmembers, and is operated on a nonprofit basis.

In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office.

When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York
8 West 40th St.

Chicago
84 East Randolph St.

Detroit
100 Farnsworth Ave.

San Francisco
57 Post St.

Men Available[1]

Executive Engineer, BSME; extensive experience in development, manufacture, installation, operation, sales, and service of automatic production machinery and process equipment. Also considerable experience in research and development of mechanical and electronic equipment. Now manager of company engaged in manufacture of special packaging machinery including flexographic presses for printing phonograph records and similar products. Prefers South. ME-374.

Chief Mechanical Engineer, BME; 42; ten years' experience in heating, ventilating, and air conditioning. Prefers West Coast or Europe. ME-375.

Mechanical Engineer, BSME; 25; two years supervisory in army, company commander Corps of Engineers; two years production and methods, electrical and rotating equipment; five years experience, production and plant maintenance, cement and allied industry. Prefers U. S. A. ME-376.

Mechanical Engineer, four years sales engineer; seven years general plant engineering, desires position in northern N. J. on problems involving generation and use of steam for industrial plants. ME-377.

General Manufacturing Manager, BSME, BS Business and Engineering Administration, M.I.T.; 35; nearly ten years' experience in manufacturing and management. Responsible for all operations and sales contacts of metal stamping and painting company. Previous experience as chief IE of multiplant electronics company. Wishes to relocate from Midwest to N. Y. area. ME-378.

Mechanical Engineer, 37, two years of boiler and steam turbine, four years water treatment, five years laboratory technician, two years construction, plant engineering, and maintenance. Prefers East Coast or South. ME-379.

Chief Engineer or Engineering Manager, MME; 30; eight and a half years drives, structures, automatic machinery on mechanical and electromechanical equipment. Prefers New York City area, N. J., Conn., L. I., or Brooklyn. ME-380.

Mechanical Engineer, presently located in Germany; Dipl.-Ing. (equivalent MS), 28, majored in heat-power engines and turbines, three years' experience in Germany, England, and U.S.A. (about one year) mostly in power-plant design: heat-cycle calculation, economic

[1] All men listed hold some form of ASME membership.

studies, design of a combined heat and power station. Able to start September, 1957. ME-381.

Industrial and Management Engineer, BSME, MSIE; 31; three years' diversified industrial-engineering experience (manufacturing methods, design approval, production; inventory control, management surveys, capital-equipment replacement (make or buy), metal-goods industry; two and a half years design and development—turbojet engines; one year production engineer ordnance products. Prefers greater New York area. ME-382.

Sales Executive, 39, 15 years' experience mechanical-product design, application, sales marketing. Excellent administrator and organizer. Thoroughly capable of all phases management, purchasing, engineering, training, advertising, accounting, emphasis on sales. Will relocate. ME-383.

Plant Engineer, BME; 32; two years' diversified training course followed by three years in plant engineering including plant layout, machine-tools installation supervision, plant facilities, better methods, preparing estimates, writing specifications for design, work-load summaries, etc. Prefers New York. ME-384.

Manager-Director Engineer, BME, BEE; 45; 22 years' experience in chemical engineering, director engineer, production manager, division manager—electromechanical and air-borne equipment. Prefers Midwest. ME-385-801-Chicago.

Executive or Chief Engineer, BScEE; 44; 25 years' development, application, and supervisory experience in machine building and automatic controls, electronic projects. Professional Engineering License. Prefers East or Midwest. ME-386-Detroit.

Positions Available

Technical Editor, under 40, electrical or mechanical degree, and some design experience. Must be able to write fluently and well, and should show evidence of such ability. Duties include the procurement, selection, writing, and editing of articles and feature departments. Salary open. Ohio. W-3334.

Methods and Production Engineers. (*a*) Methods engineer, 25–35; one for department manager; graduate mechanical, three to five years' experience in small parts fabrication and assembly, for methods analysis in fabrication, assembly and material handling for electronic devices. $8000–$12,000. (*b*) Production-control engineers, 30-45; one for department manager; engineering or business degree, with five to ten years' experience in production control, planning and scheduling, expediting, and inventory control. Duties will be in areas of experience indicated above. $8000–$12,000. (*c*) Pilot line production engineers, 30–45; one for department manager; mechanical degree and/or ten years' experience in line production and some supervisory experience; will co-ordinate all phases of manufacturing of electronic prototype developments to improve the methods, tooling, and general manufacture ability of all units developed. $8000–$12,000. Conn. W-4564.

Valuation Engineer, graduate civil or mechanical, 28–45, some practical experience in pricing or estimating current costs of utility property, either with utilities, appraisal or engineering companies, or regulatory commissions. Some construction work and cost-accounting knowledge desirable. Will participate in the development of unit costs, such as material, labor, and overheads, applicable to the inventory quantities of natural-gas utility properties. To $8400. Some travel. Ohio. W-4565.

Teaching Personnel, Instructors to Professors, rank depending upon degree and experience, for mechanical-engineering department. Courses to be taught are: thermodynamics, heat transfer, fluid mechanics, and laboratories. Should have some teaching and industrial experience. Positions available September, 1957. Midwest. W-4573.

Manufacturing Engineer in Production Management, mechanical graduate, to 50, heavy experience single-spindle and multispindle automatic screw machines; to participate in creation and management of new metal-fabrication division. Will assist in purchasing machinery and equipment, including tooling for new division. To start, $10,000 plus liberal benefits. Newark, N. J., area. W-4598.

Plant Manager for a manufacturer of inflatable plastic toys and wading pools; under 45; also pools constructed of aluminum supporting sidewall, tubular steel framework and vinyl-impregnated nylon liners, the manufacture of which closely resembles type of operation found in garment industry; therefore some experience in the garment industry desirable. Must be experienced in plant management, with a thorough knowledge of piece-rate incentive systems, plant layout, plant maintenance, cost control, production planning, and management. Ability to supervise 200 to 250 employees, mostly female, essential. About $15,000. For a period of nine to ten months, in Midwest, then plant plans to move to Mississippi and manager would have to relocate. W-4601.

Instructor of Mechanical Engineering; position available July 1, 1957. Consulting, research, and development work is available for extra compensation. $4800–$5400 for nine months' teaching. South. W-4606.

Engineers. (*a*) Mechanical engineer, research and development, graduate mechanical, 40–50, rounded background of automation, merials handling, fabrication, manufacturing, and miscellaneous equipment. Should have creative ability, imagination, design, management, and administrative experience. Stress will be put on the number of patents and patents applied for. $12,000–$15,000. (*b*) Mathematician-engineer, under 35, MA degree in mathematics, or bachelor degree in engineering, with a strong minor in mathematics; five years' experience in applied mathematics; or approximately five years' experience with a sales-application department of a manufacturer of EDP machines; or five years' experience with governmental agency in applied math. $9600–$12,000. Western Pa. W-4620.

Technical Market-Research Engineer, successful experience in the technical market-research field desirable. Should be able to formulate proposals to research management suggesting various lines of technical endeavor which will produce commercially feasible products. About $15,000. Company pays placement fee. Midwest. W-4621.

Sales Analyst, 24–29, college degree, two to three years' experience including accumulation and analysis of sales data; interpretation of sales data by charts and other acceptable methods of presentation, sales forecasting, interpretation of general economic conditions and the business climate. Will assist sales co-ordinator in all phases of developing and controlling the sales plan, analyze sales trends, and make short range projections on basis on current information, etc. Salary open. Northern N. J. W-4638.

Project Design Engineer, 35–55, engineering degree or equivalent education, five to ten years' actual drafting-board design of industrial equipment preferably heavy rolling-mill machinery; should have a working knowledge of steel or nonferrous reduction and mill practices. Will be responsible for the design of improved plant equipment, machinery, and methods; perform actual basic design work on assigned projects. Salary open. West Coast. W-4639.

Mechanical Engineer for Mechanical Power-Plant Section, 35–45, BS (ME) or better, registered professional engineer preferred; for active participation in the engineering and design of industrial and public-utility power plants. Must be able to handle preparation of heat-balance studies, preparation of power studies to obtain maximum economy in production of steam and electricity; be familiar with boiler-plant equipment such as large and small intermediate and high-pressure boilers, draft fans, turbine and motor drives, feed-water treating and heating, piping, instrumentation, etc. $9000–$11,000, depending upon experience. Eastern Pa. W-4640.

Project Engineer, graduate mechanical, to design and layout complete unit customer-built paper machinery. $8000–$10,000. Company will pay placement fee. Ohio. W-4645.

Chief Engineer, graduate mechanical, 35–45, preferably with experience in the valve industry. Will consider experience in pressure-vessel work or in pumps, compressors, and the like. Company manufactures brass and iron valves, etc. $12,000–$15,000. East. W-4657.

Chief Engineer, mechanical, 30–45, mold design, develop, cost estimate; product design, develop, cost estimate; design, develop and supervise building of jigs and fixtures; supervise moldmaking and machine shop; co-ordination with outside moldmakers. $10,000–$15,000. Mass. W-4660.

Manufacturing Engineer, 30–45, to take charge of department manufacturing custom-built swimming pools. Must have practical knowledge of filters, metals, pumps, etc. To $10,000. New York metropolitan area. W-4679.

Engineers for manufacturer of specially designed and developed heating, ventilating, and air-conditioning units. (*a*) Refrigeration engineer to follow through on engineering and development of complete refrigeration system involving compressor, condenser and evaporating coils, and all other components and controls; should have experience in the over-all handling of such projects. Systems to be worked with would involve from ten to 25 tons of refrigeration. Should have from five to ten years' experience with one of the major manufacturers such as Carrier, York, Worthington, etc. Salary open. (*b*) Project or product engineers, experienced in handling a complete engineering and development project to the point where it is ready for manufacturing. Graduate mechanical engineer, experience with heat transfer, thermodynamics, and air flow. To $10,000. (*c*) Purchasing manager, engineering background preferred, to purchase components for above equipment and negotiate with subcontractors. Should have had experience in purchasing with ability to purchase nonstandard items at favorable cost and to expedite and schedule parts and assemblies. To $10,000 a year. Midwest. W-4683.

General Sales Manager, Overseas Markets, college degree or equivalent, over 35, for sale of office machines. Must have a successful record in sales management, preferably in the office-machines industry, including electric typewriters. Some experience in marketing products through branches and distributors at home and overseas. Should be familiar with marketing research. Knowledge of language such as French, Spanish, and German. To $25,000 depending on experience, plus retirement and other benefits. Headquarters, New York, N. Y., frequent trips abroad. W-4686.

Assistant Professor, MS preferred, to teach courses in the field of industrial engineering with interests in research, the development of graduate work, and in the newer application of mathematics to industrial engineering. Practical experience valuable. Consulting work permitted. $5070–$6474 for academic year. New England. W-4687 (*a*).

Instructor, Assistant or Associate Professor, to teach in mechanical engineering, particularly courses in machine design or heat-power fields. Available Fall, 1957. Position and salary based upon qualifications and experience. Midwest. W-4693.

Engineers. (*a*) Research and development engineer, two to five years' previous engineering experience preferably including some steam-plant background, to work from original or suggested ideas in designing and development of new products or modification of existing units. Salary open. (*b*) Design engineer, one to three years' previous engineering experience, preferably including some steam-plant background to prepare new designs, design improvements, and special applications of standard products. Salary open. (*c*) Assistant sales manager, at least five years' previous outside and administrative engineering-sales experience to serve as line assistant to product-sales manager. Knowledge of handling sales of products through distributors and of steam-plant specialty equipment would be extremely valuable. Salary open. Salaries and benefit program including profit sharing. Eastern Pa. W-4695.

Mechanical Designers, under 30, good academic background in mechanical engineering, and a few years' experience in automotive chassis, aircraft structure, or commercial vehicle design. Should possess ability to supervise draftsmen and work effectively with production personnel. $8000–$10,000. Company pays interview, relocation, and placement-fee expenses. Vicinity of Philadelphia, Pa. W-4699.

General Manager, preferably in early 40's, management experience in manufacturing, sales, engineering, preferably in precision-instrument manufacture. $25,000–$30,000. New York Metropolitan area. W-4708.

Senior Industrial Consultant, 35–40, degree, ten years' experience in any two of the following: industrial engineering, accounting systems procedure, production or quality control, market research, corporation finance, for management consulting staff. Salary open. Pa. W-4710.

Plant Engineer, 35–45, graduate mechanical, electrical, or civil, about ten years' experience in construction, maintenance, and some design. Nonferrous experience preferred but not required, other acceptable experience: steel, manufacturing, operations, or construction. Responsibility will include maintenance of up-to-date drawings and surveys of plant equipment and facilities, to design small projects required by operating departments and to maintain liaison between headquarters office and plant construction group. $8000–$10,000. Okla. W-4714.

Engineers, (*a*) Chief time-study engineer, mechanical graduate, at least five years' supervisory time-study, methods, and industrial-engineering experience in light metalworking

fields. $8500. (*b*) Junior time-study engineer, mechanical-engineering training and machine-shop experience. $4700–$5700. Newark, N. J., area. W-4718.

Manufacturing Manager, 40–50, graduate, responsible for all manufacturing maintenance of adequate plant capacity and work force. Fifteen years' experience in either metals, rubber, or plastics desirable but not essential; both job order and mass production. $15,000. New England. W-4720.

Executive Assistant to the President, medium-sized manufacturer, 35–42, graduate, to coordinate market research, corporate planning, sales analysis, and control. Will have budgetary control, higher-level wage and salary administration, and control of capital expenditures. $13,000 plus. New England. W-4721.

Sales Engineer, 30–40, preferably a mechanical engineer, to sell equipment for company manufacturing corrosion-resistant heat-exchange units used for both heating and cooling, a complete line of corrosion-resistant ventilation equipment for the handling of corrosive fumes and a complete line of specialized tank equipment used for chemical service. New York metropolitan area. W-4723.

Vice-President, Research and Development, 37–55, PhD in one of the physical sciences or engineering, for a manufacturer of specialized equipment, machinery, and other metal products. Must have solid technical background and broad research experience in some area of the physical sciences, preferably in a branch of mechanical engineering such as thermodynamics, aerodynamics, heat transmission, or related areas. Will be responsible for administering a widely varying, highly complex series of applied research and long-range development matters. About $35,000 base, plus incentive bonus; also liberal stock option, insurance, pension, and other fringe benefit plans. Northeastern United States. W-4726.

Senior Designer, mechanical graduate, at least ten years' supervisory design and layout experience covering heating and air-conditioning facilities in commercial and industrial buildings. $7800–$9100. New York, N. Y. W-4731.

Engineers. (*a*) Machine designer, five or more years' experience in automatic machine design, preferably in paper board, carton, or packaging-machine manufacturing. $9000. (*c*) Mechanical engineer for research and engineering. Some drafting and design experience, to train for project engineer or machine designer. Recent graduate accepted. $5200, and up. Company will pay placement fees. Mich. W-4732CD.

Editorial Assistant, EE or ME or equivalent in experience; with wide knowledge of power and plant-engineering practices in public-utility and/or industrial fields for editorial staffs of engineering magazines; applicants should be able to write clearly, present material logically to their audience, be interested in new developments, like to travel and meet people, work well with others and be interested in a permanent position where ingenuity, versatility, and imagination can be combined with common sense and knowledge of the field to create a career; prior editorial knowledge is of no advantage. Salary open. Employer will negotiate the fee. Chicago, Ill. C-6050.

Editor, ME or EE graduate, 20 to 25 years' experience in public-utility and industrial fields; familiar with all phases of plant design, construction, operation, and maintenance of steam, hydro, diesel, compressed-air and refrigeration equipment; in addition to a wide and varied technical background this man must have good personality, like to travel and meet people, maintain an interest in new development, sense significant trends and relate them logically to the readers of an engineering magazine of international circulation; applicant probably has held many positions none of them providing full scope for versatility, ingenuity, and imagination. Salary open. Employer will negotiate the fee. Chicago, Ill. C-6049.

Project Engineer, ME or EE, to 57; five or more years' experience in laundry equipment, such as washers or driers. Will conceive ideas, do designing and development work on laundry equipment or new products for a manufacturer; must be willing to live in town of about 10,000 population. Up to $12,000. Employer will pay the placement fee. Ill. C-6039.

Candidates for Membership and Transfer in ASME

The application of each of the candidates listed below is to be voted on after April 25, 1957, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and ●Transfers

Alabama

Thomson, Jerry, Birmingham

Arkansas

Pierce, Jesse N., Little Rock

California

Clifford, Lloyd E., Berkeley
● Fiock, William L., San Jose
Lehmann, Frederick E., Los Angeles
Pauly, Joachim W., San Leandro
Richards, William B., Saratoga
Tepper, Ira, Los Angeles
Vitols, Valentin, Berkeley
Willis, Stanley E., Santa Monica
Wolcott, John R., San Jose

Colorado

McCormack, James A., Denver

Connecticut

Chapell, Alexander R., Norwalk
Di Pasquantonio, Ernest A., Stamford
Griffith, John E., New Haven
Hussey, George F., Jr., Norwalk
● Spaulding, Harold E., Bridgeport

Delaware

Duffy, Edward P., Newark
Wills, Thomas M., Wilmington

District of Columbia

Tolbert, Alvin J., Washington

Florida

Clendening, Daniel B., Pensacola
Kaufman, Eugene, Merritt Island
Mathews, Joseph L., Pensacola
Thrasher, James W., Jr., Pensacola

Georgia

Allred, Sanders R., Atlanta
Spires, Joseph F., Atlanta

Idaho

Marrs, Charles A., Idaho Falls
McKim, William H., Idaho Falls
McVey, Marvin E., Idaho Falls

Illinois

Baermann, Edwin R., Elmhurst
Bielenberg, Robert G., Chicago
Douglas, Robert A., La Grange
Ehringer, Edward J., Knoxville
Hertlein, Clyde D., Arlington Heights
● Hirschhorn, Harry J., Chicago
Honma, Tsuneo T., Chicago
Knappe, LaVerne F., Park Forest
McDonald, Harry W., Moline
Poolos, Nich J., Chicago
Raccoll, Theodore, Chicago
Serly, Robert M., Alton
Thompson, Charles R., Bloomington
Ziemer, Richard W., Chicago

Indiana

Kelsey, Maurice L., Indianapolis
● Myers, Lowell E., Fort Wayne

Iowa

Livingston, Burt R., Newton

Kentucky

● Gabriel, Richard H., Louisville

Maine

● Vozella, John J., Rumford

Maryland

Humbert, Clyde O., Baltimore
Reuwer, Milton J., Army Chemical Center
Selig, Seymour M., Army Chemical Center

Massachusetts

Burke, Stanley A., Westfield
Erikson, Erik B., Medford
Lauber, Thornton S., Lanesboro
Olsson, John E., Lynn
● Pryde, David R., Pittsfield
Whitten, Francis M., Holliston
Wyland, G. Alan, Rowe

Michigan

Frey, Donald N., Dearborn
McLarty, Lowell K., Alpena
Oravas, Gunhard A., Detroit

Missouri

Boon, George B., St. Louis
Cymny, Gerald A., St. Ann
Edmundson, Charles W., Kansas City
Hereford, Don K., Kansas City
Knuth, Jack A., Hickman Mills

Nebraska

Rosenzweig, Norman, Omaha

New Jersey

Cohen, Lawrence, Clifton
Eisenstein, Albert, Irvington
Gitterman, Henry, Teaneck
Guarracini, Joseph, Collingswood
● Krutzsch, William C., Jr., Morristown
Marshall, George B., Westfield
● McGovern, John P., South Orange
Ramsey, Raymond E., Ridgefield
Romero, Joseph, Newark

New Mexico

Hegge, Joseph I., Albuquerque

New York

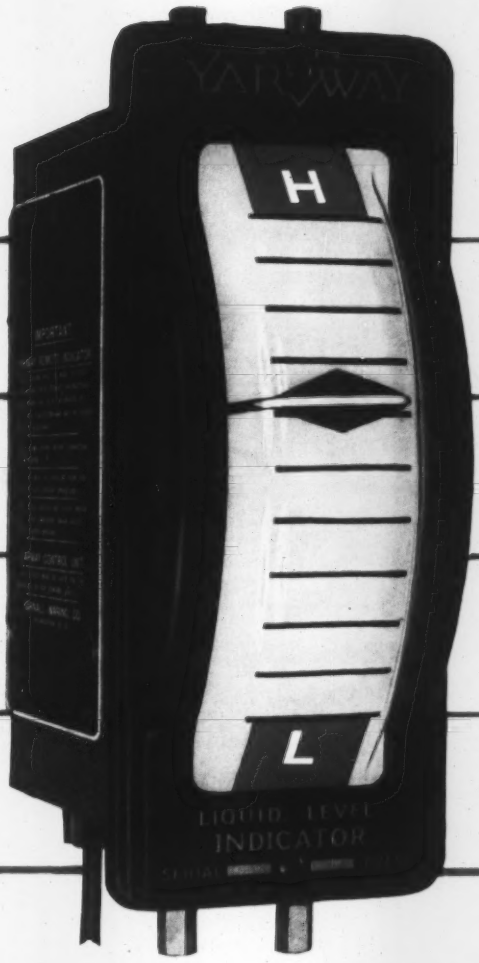
Anderson, Arthur N., New York
Bloomfield, James S., Port Washington
Bramson, Clive H., Kings Point
Brick, Lawrence, New York
Bush, Richard J., Oakland Gardens
Card, Paul R., Buffalo
Crowell, William F., East Aurora
Dibelius, Norman R., Ballston Spa
Dimenstein, George N., New York
Gohn, George R., New York
Hartford, John F., Utica
Jardmo, Sven A., New York
Jettinghoff, Johannes A., Pelham
Jewsbury, C. William, Buffalo
Kofkin, Stanley I., Westbury
Levinson, Mark, Brooklyn
Lowen, Gerard G., New York
Magnus, Daniel E., Great Neck Plaza
Manusakis, Constantine, Great Neck
Meany, Bernard A., Poughkeepsie
Muir, James F., Rochester
Oran, Frederic M., Brooklyn
● Osofsky, Irving B., Cheektowaga
Parry, David A., Scotia
Petrucci, Joseph W., Schenectady
● Ream, Charles E., Johnson City
Rocks, Eugene S., Bellerose
Ruhl, Hesser K., Schenectady
Schaefer, Thomas P., Lancaster
Schroeder, Arthur H., Glenham
Schwarz, Harry A., Whitestone
Silbertrust, Norman, New York
Spielman, Lester, New York
Tipikin, George J., New York
Toland, Charles F., Great Neck
Trimble, Glenn A., New York
Weixler, Ralph A., New Hyde Park

North Carolina

Boone, Charles D., Winston-Salem
Hillen, Earl, Jr., Charlotte

● Transfer to Member or Affiliate.

(*ASME News continued on page 422*)



boiler water levels now easier to **see**... easier to **read**

Whatever the boiler pressure, high or low, YARWAY Remote Indicators give accurate, instant, eye level boiler water level readings at any convenient plant location.

Boiler Code Case No. 1155* says in part, "... two independent remote level indicators of the compensated manometric type may be used instead of one of two required gage glasses for boiler drum water level indication in the case of power boilers with all drum safety valves set at or above 900 psi..."

YARWAY Remote Liquid Level Indicators fill the bill—and feature a "wide vision" face that makes reading easier from any angle.

Accurate—because indicator is actuated by the boiler water itself—by the pressure differential between a constant head and the varying head of water in the boiler drum.

Also use YARWAY Remote Indicators on heaters of various types.

For full description, write for YARWAY Bulletin WG-1824.

*Write for free reprint of case description.

Yarway Remote Hi-Lo Alarm Signals—lights or horns—can be used with Yarway Remote Liquid Level Indicator and placed at any location in the plant.

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DAVIS, KENT L., Jr., Euclid
DEVADAS, KRISHNASWAMY, Cincinnati
DUFFY, PAUL E., Cincinnati
● HARTLEY, RICHARD S., Troy
HUFFER, WILBUR L., Alliance
MELCHER, FRANK T., Jr., Cleveland
● MILLER, DAVID I., Euclid
SCHRONDER, ROBERT W., Canton
SMITH, HOWARD E., Dayton
SNIDER, MERVIN C., Akron
WEISMAN, DAVID, Cleveland

Pennsylvania

● BECKER, JULES S., Philadelphia
BOECKELER, BENJAMIN C., Latrobe
CAPPS, OVERTON B., Pittsburgh
DURCHMAN, OLLI, Erie
FREISMUTH, KENNETH E., Finleyville
GILSDORF, DAVID R., Pittsburgh
HANSON, THOMAS L., Erie
HILFICKER, EDWARD G., Philadelphia
HORINE, JOHN W., Philadelphia
HUGHES, WILLIAM P., Irwin
● JACKOVITZ, JOSEPH J., Allentown
JARMAN, WILLIAM H., Philadelphia
KNAPP, ROBERT P., Pittsburgh
LOUGHREY, JOSEPH R., Berwick
REIMANN, NICOLAUS G., Philadelphia
● RUMSEY, CLAYTON S., Erie
SCHAEFER, ADOLPH O., Norristown
SICKLER, ROLAND B., Jeannette
SOHRE, JOACHIM S., Jeannette
THORN, JOSEPH H., Greensburg
ZUZIK, JOSEPH B., Hannastown

Rhode Island

● CHAMBERLAIN, WILLIAM H., Barrington
EGGE, EDWIN G., Riverside
GREENWOOD, CHARLES W., Westerly
HAYTHORNTHWAITE, ROBERT M., Providence

Tennessee

JONAKIN, JAMES, Chattanooga
PALKOWSKI, DANIEL H., Oak Ridge

Texas

COLEBROOK, ROSS W., Houston
COOK, JAMES M., Freeport
LIMBS, JAMES R., Borger

Virginia

RIMMER, ROBERT V., Staunton
SMOLLON, FRANK J., Jr., Falls Church
TODD, FREDERICK S., Newport News

Washington

CAMPBELL, R. BRUCE, Spokane
EDWARDS, JOHN H., Spokane
NEWELL, GLEN A., Richland
SAMPSON, ALLAN G., Richland
SIEGEL, WILLIAM A., Richland
WOOD, DAVIS M., Spokane

West Virginia

CAUDLE, STANFORD V., Montgomery

Wisconsin

ELY, DONALD A., Beloit
KIPER, ALI M., Racine
PEZL, JOHN F., Marshfield
PIERCE, WILLIAM C., Beloit

Foreign

ACHARYYA, SUBODH C., Durham, England
COLEMAN, FRANK C., Fredericton, N. B., Canada
FORTEMPS, HENRY R., Elisabethville, Congo Belge
HALL, BARRIE, Montreal, P. Q., Canada
HAWTHORNE, JOHN A., Nassau, Bahamas, B.W.I.
MELNYK, JURIJ G., Toronto, Ont., Canada

Transfers from Student Member to Associate Member, Class of 1956 35

Obituaries

Julio G. Bejarano (1902–1956), plant manager, Shell Chemical Corp., Denver, Colo., died Oct. 24, 1956. Born, Escorial, Spain, Feb. 7, 1902. Parents, Gabriel and Julia (Gomez) Bejarano. Education, graduate, National Institute of Chile, 1919; BS, University of California, 1926. Married Isabel Llinas, 1933. He was a specialist in the design, construction, operation, and management of a high-pressure ammonia synthesis plant. Jun. ASME, 1926; Mem. ASME, 1942. He is survived by his widow and three children, Mrs. Isabel Park, DeRidder, La.; Patricia and Julio, Denver, Colo.

Gustaf F. Blixt (1890–1957), chief engineer, Ultra Chemical Works, Paterson, N. J., died Jan. 3, 1957. Born, Colon, Panama, Oct. 23, 1890. Parents, Gustaf and Sarah (Casson) Blixt. Education, ME, Stevens Institute of Technology, 1915. Married Hazel May Freeland, 1917. Jun. ASME, 1916; Mem. ASME, 1923. He is survived by Mrs. Blixt, and two sons, Gustaf F., Pines Lake, N. J., and William C., The Weirs, N. H.

William Wray Boyd (1889–1956), engineer, Flexitallic Gasket Co., Camden, N. J., died Dec. 7, 1956 in Philadelphia, Pa. Born, Eufala, Ala., Dec. 19, 1889. Parents, Clary Lynn and Willie Lee (Crow) Boyd. Education, BS(Arch), Alabama Polytechnic Institute, 1911. Married Hester Blair, 1918. Assoc.Mem. ASME, 1922; Mem. ASME, 1937. Mr. Boyd served in the U. S. Army in World War I. He was the author of technical articles which appeared in trade publications. He is survived by his widow and two children, William W., and Mrs. C. Fred Morton.

John Edward Casey (1893–1956), chief engineer, Jersey Central Power and Light Company, South Amboy, N. J., died Oct. 22, 1956. Born, East Brooklyn, Conn., Jan. 3, 1893. Parents, John and Mary Casey. Education, high-school graduate; 7 years, New London Night School. Married Vivian B. Lavallee, 1915; children, 2 daughters and 4 sons. Mr. Casey had been a specialist in fuels and combustion. He was a long-service member of the Connecticut National Guard and served as a lieutenant in the U. S. Army during World War I. Assoc-Mem. ASME, 1924; Mem. ASME, 1935.

Fred Cecil Eastman (1889–1956?), whose death was made known recently to the Society had been a research engineer with United Shoe Machinery Corp., Beverly, Mass. Born, Swampscott, Mass., Oct. 30, 1889. Education, BS, Tufts Engineering School, 1914. Mem. ASME, 1928. Mr. Eastman was a specialist in the design of shoe machinery.

Leigh R. Evans (1884–1956?) whose death was reported recently to the Society, had been vice-president of Morrison Machine Products, Inc., Elmira, N. Y. Born, Easton, Pa., Jan. 27, 1884. Education, BS(ME), Cornell University, 1907. Mr. Evans had been a specialist in gas-engine design and manufacture. Mem. ASME, 1918.

Charles B. Harbin (1895–1956), president, Acme Machine and Die Makers, Atlanta, Ga., died Dec. 31, 1956. Born, Tate, Ga., Jan. 8, 1895. Parents, John W. and Roxie (Corn) Harbin. Education, high-school graduate; Tool and Die Design home-study course. Married Elizabeth Sheffield, 1942. Mr. Habin held patents for a metal casket, radio condenser, and a toolmaker's indicator. Mem. ASME, 1942.

F. G. Hechler (1884–1956), consultant, Bureau of Foreign Commerce, Washington, D. C., and professor, The Pennsylvania State College, died Dec. 1, 1956. Born, Dalton, Mo., Sept. 28, 1884. Parents, George and Elizabeth (Sassee) Hechler. Education, BS(ME), University of Missouri, 1908; ME, University of Missouri, 1910. Married Anne Evans Griffith, 1911; children, Catherine, Helen, Jean. He served the Society as member of the Special Fluid Meters Committee, 1919–1927; as Chairman, Central Pennsylvania Section, 1933; Oil and Gas Power Division, 1939–1940. Between 1928 and 1940 Prof. Hechler supervised the design of and prepared specifications for heating and ventilating installations for 21 major college buildings. He was the author of many articles and bulletins on steam traps, balancing machines, heat transmission for buildings, and insulation materials and boiling refrigerants. Assoc-Mem. ASME, 1915; Mem. ASME, 1929; Fellow ASME, 1950.

William E. Helmstaedter (1878–1956), retired plant engineer, died Nov. 30, 1956. Born, Newark, N. J., March 3, 1878. Parents, George J. and Margaret Helmstaedter. Education, BS(ME), Cooper Union, 1911. Mem. ASME, 1915. Mr. Helmstaedter had been associated with The Celluloid Corp., Newark, N. J.

Gustave Henry Kuechler (1898–1957), manager of licenses and associated companies for Combustion Engineering, Inc., died Jan. 9, 1957. Born, Brooklyn, N. Y., Feb. 18, 1898. Education, Pratt Institute, 1916; Brooklyn Institute of Technology. Mem. ASME, 1945. Mr. Kuechler served as an aviation instructor with the Signal Corps in World War I. He aided in the design of steam-power stations here, including two units of the Consolidated Edison Co. of New York. Mr. Kuechler is survived by his widow, Helen, and a son, Karl.

Oscar Ira Lessig (1905–1956), mechanical engineer with the Army Chemical Corps, Fort Detrick, Frederick, Md., died Dec. 16, 1956, at his home, Poolesville, Md. Born, Versailles, Ind., Nov. 6, 1905. Education, Indiana schools and colleges, ICS. Married Helen Morrissett. Assoc. Mem. ASME, 1956. Charter Mem. of Western Group. With the Navy Department for 20 years, he had helped to design the guns for the battleship *US Missouri*, and also served as an engineer with the first Bikini Atoll atomic bomb test group in 1946.

Charles Hayes Logue (1875–1956), authority on gears, died Dec. 31, 1956, Marcellus, N. Y. Born, Cleveland, Ohio, July 4, 1875. Parents, Lloyd Garrison and Emma (Allerton) Logue. Education, common schools and ICS. Married Mary Elmes, 1899; children, Donald Charles and Helen Elizabeth. Mem. ASME, 1922. Mr. Logue was the author of many books, including the "American Machinist Gear Book," 1910; and many articles and papers presented before the ASME. He was the recipient of the Panama-Pacific Gold Medal, 1915; and in 1925 was selected by the American Gear Manufacturers Assoc. as one of the seven outstanding gear authorities in this country. He held 16 patents pertaining to gears.

John F. Mattern (1887–1956), production survey specialist, Department of the Navy, Washington, D. C., died April 10, 1956. Born, Washington, D. C., Sept. 12, 1887. Parents, Harry Julius and Lillie (Heider) Mattern. Education, BS(ME), The Pennsylvania State College, 1910. Married Alice Rickabaugh, 1911. Mr. Mattern was a past president of the Pittsburgh Personnel Association and a member of the Western Pennsylvania Industrial Conference (Y.M.C.A.). Mem. ASME, 1922.

James K. McIntyre (1880–1956), chief engineer, Dean Pumps Inc., Indianapolis, Ind., died Nov. 20, 1956. Born, St. Johns, New Brunswick, Canada, July 6, 1880. Parents, Andrew H. and Elizabeth McIntyre. Education, technical high-school graduate. Married Sarah Hornbeck, 1913. Mem. ASME, 1940. His widow and two sons, Dr. J. M., Indianapolis, Ind., and Robert L., London, England, survive him.

Ralph Kenneth Mongeon (1933–1956?), methods engineer, Reed-Prentice Corporation, Worcester, Mass., died recently. Born, Worcester, Mass., Oct. 1, 1933. Education, BS(ME), Worcester Polytechnic Institute, 1955. Assoc Mem. ASME, 1955.

Egbert Moxham (1881–1956), president, Concrete Products, Inc., Brunswick, Ga., died June 17, 1956. Born, Birmingham, Ala., Aug. 18, 1881. Parents, Arthur J. and Helen T. (Coleman) Moxham. Education, University schools; Cornell University. Married Dora Coleman Phillips, 1906; children, Zara du Pont, Egbert, Arthur James. Mr. Moxham served with the U. S. Army Ordnance as a major and lieutenant colonel, 1917–1919. Within a few months of his death Mr. Moxham would have been the recipient of the Society's Fifty Year Membership Pin.

Frederick A. Muschenheim (1871–1956), for many years operator of the Astor Hotel, New York, N. Y. died Dec. 17, 1956. Born, Braunfels Germany, February, 1871. Education, ME, Stevens Institute of Technology, 1891. Married Elsa Unger, 1901; children, Dr. Carl, New York, N. Y.; William, Ann Arbor, Mich.; and Mrs. Channing K. Jaques, New York, N. Y. Married 2nd Laura C. Jacobus. Mr. Muschenheim, with his older brother William, were among the first to be associated with the Astor Hotel. He designed and supervised the installation of electrical and mechanical service systems which were advanced for the time. In 1918, on the death of his brother, he assumed full direction of the hotel. When a corporation was formed in the late thirties, he became its president, a position which he held until 1944, and its chairman until his retirement in 1954. Mr. Muschenheim was

(ASME News continued on page 424)

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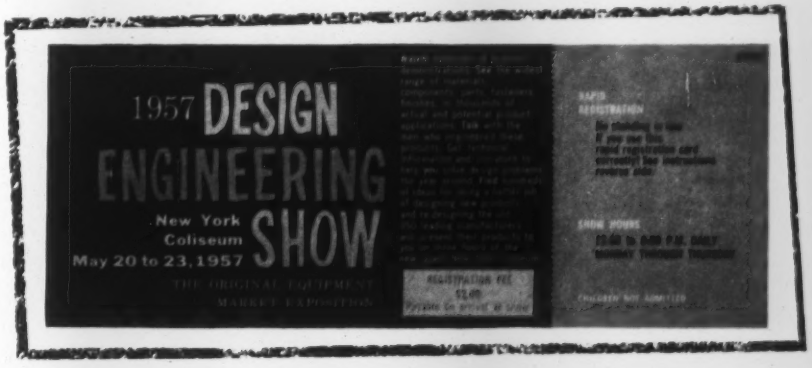

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The master file also indicates the Professional Divisions in which members have expressed an interest. Many Divisions issue newsletters, notices of conferences or meetings, and other material. You may express an interest in the Divisions (no more than three) from which you wish to receive any such information which might be published.

Your membership card includes key letters, below the designation of your grade of membership and year of election, which indicate the Divisions in which you have expressed an interest. Consult the form on this page for the Divisions to which these letters pertain. If you should wish to change the Divisions you have previously indicated, please so notify the Secretary.

It is highly important to you and to the Society to be certain that our master file indicates your current mailing address, business or professional-affiliation address, and interests in up to three Professional Divisions.

Please complete the form, being sure to check whether you wish mail sent to your residence or office address, and mail it to ASME, 29 West 39th Street, New York 18, New York.

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ASME Master-File Information

Date

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POSITION TITLE NATURE OF WORK DONE
e.g., Design Engineer, Supt. of Construction, Manager in Charge of Sales, etc.

NAME OF EMPLOYER (Give name in full) Division, if any

* ☐

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☐ Mechanical Engineering	10th of preceding month
☐ Transactions of the ASME	20th of preceding month
☐ *Journal of Applied Mechanics*	20th of preceding month
☐ *Applied Mechanics Reviews*	1st of preceding month

Professional Divisions in which I am interested (no more than *three*) are marked X.

☐ A—Aviation	☐ J—Metals Engineering	☐ S—Power
☐ B—Applied Mechanics	☐ K—Heat Transfer	☐ T—Textile
☐ C—Management	☐ L—Process Industries	☐ U—Maintenance and Plant Engineering
☐ D—Materials Handling	☐ M—Production Engineering	☐ V—Gas Turbine Power
☐ E—Oil and Gas Power	☐ N—Machine Design	☐ W—Wood Industries
☐ F—Fuels	☐ O—Lubrication	☐ Y—Rubber and Plastics
☐ G—Safety	☐ P—Petroleum	☐ Z—Instruments and Regulators
☐ H—Hydraulics	☐ Q—Nuclear Engineering	
	☐ R—Railroad	

head of the Hotel Association of New York for nine years. He was a member of the board of trustees of Stevens Institute, which awarded him an honorary DE degree in 1952. He was also on the boards of the Franklin Savings Bank and the Lenox Hill Hospital. Mem. ASME, 1915.

Cornelius J. H. Penning (1883–1956?), consultant for the cane-sugar industry, died recently. Born, Rotterdam, Holland, Dec. 15, 1883. Education, Technical School, Amsterdam, 1904. Married Lily Sidwell Brock, 1915; one son, John. Mem. ASME, 1921. Mr. Penning was a specialist in sugarhouse machinery and plantation equipment. He was an incorporator and occasional contributor to *Sugar News*.

George Stanley Radford (1881–1956), industrial management consultant, La Jolla, Calif., died Dec. 28, 1956. Born, Detroit, Mich., May 20, 1881. Parents, George W. and Laura F. (Doolittle) Radford. Education, BS, United States Naval Academy, 1903; MS, Massachusetts Institute of Technology, 1905. Married Clara Kerr McCormick, 1906. Between the years 1903 and 1905, Mr. Radford was an officer in the U. S. Corps of Naval Constructors; from 1910 to 1915 he was on the staff of the Chief Constructor in Washington, D. C. He served also as an advisory engineer with the Remington Arms Co., Bridgeport, Conn., and as a contract manager with the U. S. Shipping Board, Emergency Fleet Corp. From 1918 he served as a consulting engineer for a number of varied industries. Mr. Radford wrote the pioneer work on "The Control of Quality in Manufacturing," and many related technical articles. Mem. ASME, 1915; Fellow ASME, 1941.

Clarence Edward Rose (1887–1956?), whose death was recently reported to the Society, was a specialist in determination of the most technically and economically sound heat balance, and in the application of a method of symmetrical components. Born, Little Rock, Ark., Oct. 2, 1887. Education, BS(ME&EE), Cornell University, 1905; LLD, Cornell University, 1928. Mr. Rose was employed by the U. S. Government from 1933 until 1953, during which time he held such positions as Senior Engineer Examiner under Secretary of the Interior, H. L. Ickes, and Electrical Engineer with the Department of the Navy. He was the author of articles which appeared in the technical press and several books. Mem. ASME, 1954.

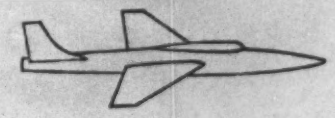
John W. Schreiber (1883–1955?), whose death was recently reported to the Society, was a construction engineer with the Aluminum Co. of America, Pittsburgh, Pa. Born, Pittsburgh, Pa., June, 1883. Education, BS(ME), University of Pittsburgh, 1907. Jun. ASME, 1914; Mem. ASME, 1935.

Alexander George Walker (1911–1956), chief engineer, Kent Machinery Co., Cuyahoga Falls, Ohio, died Nov. 28, 1956. Born, Cuyahoga Falls, Ohio, Dec. 31, 1911. Education, BS(ME), University of Akron, 1936. Jun. ASME, 1936; Mem. ASME, 1945.

Albert Easton White (1884–1956), director of the University of Michigan's Engineering Research Institute from 1920 to 1953, and a consulting metallurgical engineer, died Dec. 18, 1956, Ann Arbor, Mich. Born, Plainville, Mass., March 12, 1884. Parents, Albert Nelson and Martha (Easton) White. Education, AB, Brown University, 1907; postgraduate study, Harvard University, 1908; hon. DS, Brown University, 1925. Married Margaret Bell Arnold, 1911; one son, Arnold Easton. Married 2nd, Elsie Speckman Hausgwald, 1935. An authority on high-temperature metallurgy, Professor White was largely responsible for the development of the University of Michigan's Engineering Research Institute, from a small organization involving a small group of researchers to an institution which carried on over 8 million dollars worth of research. During World War I, he served as captain and major with the Inspection Division, Ordnance Department. Again in the second world war, he served his country as Chairman of the Metallurgical Research Committee of the National Defense Research Council and a member of the Metallurgical Committee of the Office of Scientific Research and Development. He was the author or co-author of 10 books and bulletins on various aspects of metallurgical research, and 160 articles published in technical and professional journals. He was instrumental in founding the American Society of Metals and served as its first president. He served also as the president of the American Society for Testing Materials. Mem. ASME, 1923; Fellow ASME, 1946. His services to the Society included the following: Main Research Committee, member, 1924–1929, and chairman, 1929; Special Research Committee on Condenser Tubes, chairman, 1925–1953; Nominating Committee, chairman, 1931; Manager, 1942–1944.

ZERO LEAKAGE

Precision "O" Rings answer another sealing problem



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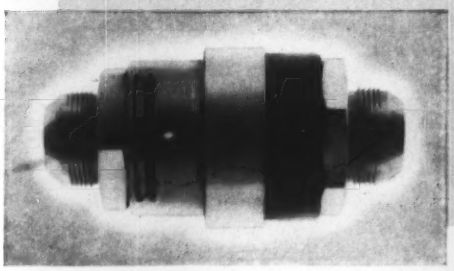

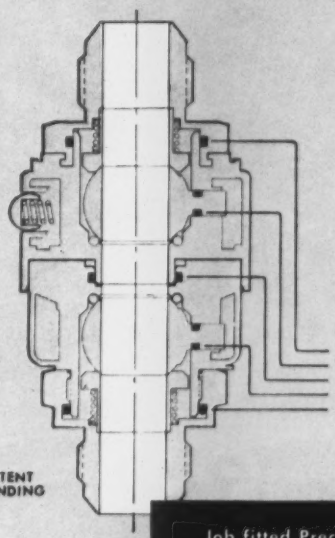

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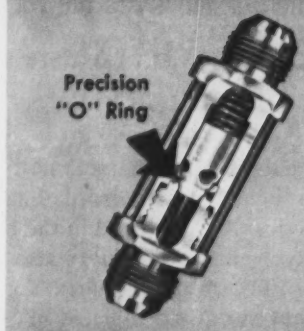

Precision "O" Rings in Kepner Products "Kep-O-Seal" Check Valves effectively seal against external and internal leakage. Positive action from 1 to 5000 PSI, in temperature range of —40 F to 280 F.

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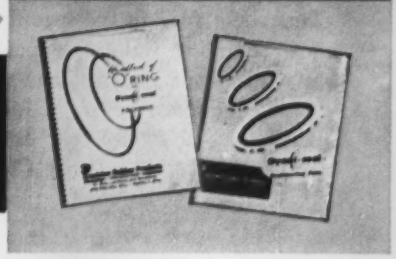

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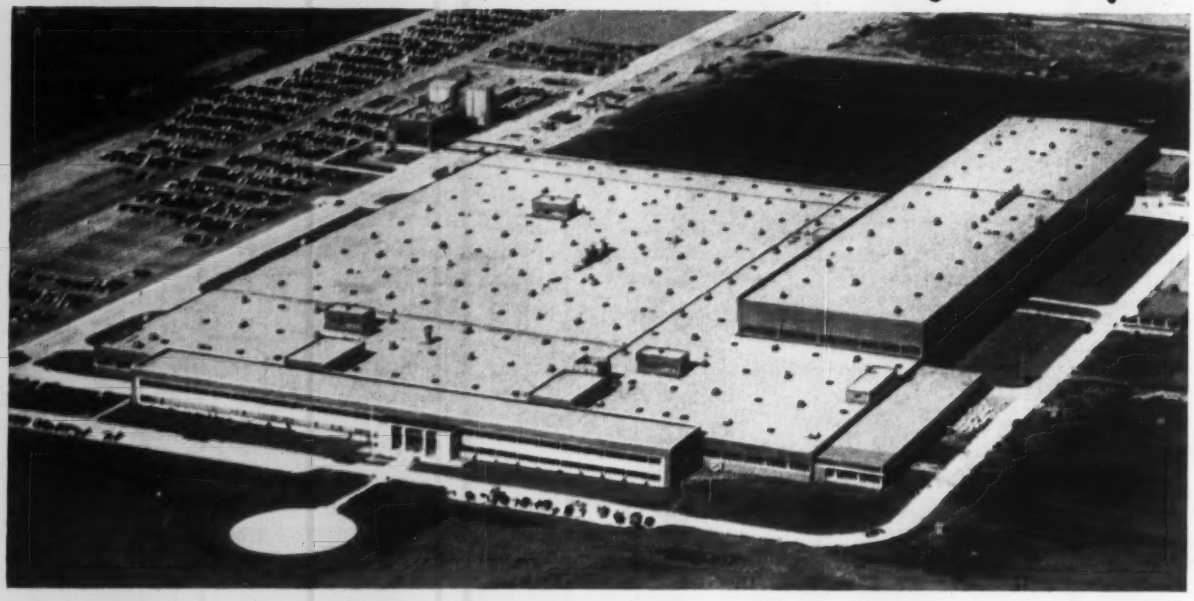

Architects and Engineers: F. A. Fairbrother and George H. Miehls, Detroit; with Albert Kahn Associated Architects and Engineers, Detroit, as consultants.

General Contractor: E. & F. Construction Co., Bridgeport.

Mechanical Contractor: John Winkle, Inc., Larchmont, N. Y.

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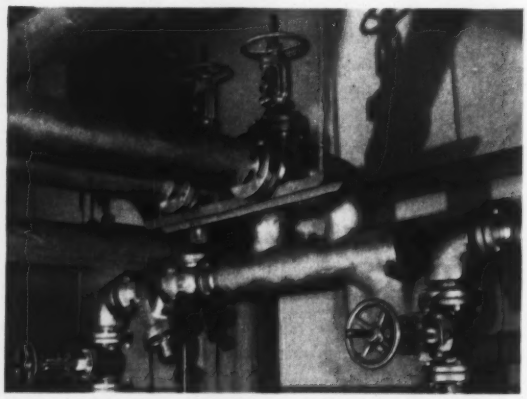
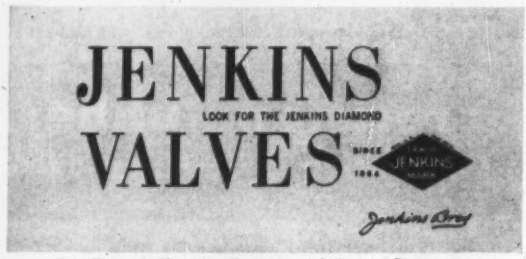
On the valves to control much of the complex network of pipelines, management, architects, engineers and contractors found it easy to agree. From long experience on many jobs all could be sure of the reliability of Jenkins Valves.

This confidence in the specification "Jenkins", has been shared by building experts and plant operating men alike for 93 years. The valves that have won this great confidence bear the Jenkins Diamond trademark . . . and *they cost no more*. Jenkins Bros., 100 Park Ave., New York 17.



JENKINS VALVES shown controlling heating lines. Used throughout the Sikorsky plant on steam, water, air and process piping.



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LATEST INDUSTRIAL LITERATURE

Those in industry who are responsible for various phases of plant, machinery, and product design, production, operating and application engineering will find much to interest them in this NEW CATALOGS Guide. Here, reputable manufacturers, most of whom have current advertising in MECHANICAL ENGINEERING and MECHANICAL CATALOG, offer to send you without obligation, their latest literature which is described on pages 43 to 86.

FOR convenience in locating catalogs about particular equipment, product or service, a list is given below in which the numbers refer to the catalog items beginning on page 43. This will aid you in locating something specific although a perusal of the entire list may disclose other items of more than usual interest to you.

This April 1957 insertion of NEW CATALOGS Guide replaces the regular "Keep Informed" Section for this issue. The "Keep Informed" Section will appear regularly again beginning with the next issue.

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Read the various items listed . . . one catalog may hold the solution to your present problem . . .

1 SPEED REDUCERS

Western Gear Corp.—Bulletin No. 5616 covers the company's Strait-Line speed reducers. Dimensional information is tabled and diagrammed, and specifications, ratios and performance data is included.

2 TORSIONAL VIBRATION DAMPER

Houdaille Industries, Inc., Buffalo Hydraulics Div.—A brochure describes the operation and use of viscous torsional vibration dampers. It includes a data sheet required to apply this damper to internal combustion engines and rotary systems likely to have critical speeds in the operating range. The damper is untuned and said to provide highly efficient damping even when damper is not optimum for the system.

3 ROTARY COMPRESSOR

Ingersoll-Rand Co.—Form 2307 illustrates and describes the new Gyro-Flo 85 cfm portable rotary compressor. This new compressor weighs 1840 lb, is equipped with tool boxes, fenders and two-wheel spring mounted running gear. As a truck mounted unit, the Gyro-Flo 85 weighs 1375 lb.

4 CENTRIFUGAL PUMPS

Dean Brothers Pumps Inc.—Literature describes a new line of standard, close coupled, centrifugal pumps designed to handle a wide range of general applications where conditions do not necessarily require a more costly "engineered" pump. Identified as Type "GSC," the line comprises seven pumps with capacity up to 600 gpm and total dynamic head up to 275 ft. Temperature range of liquids that can be pumped is from −40 to +250 F.

5 SOLIDS-CONTACT REACTORS

Cochrane Corp.—Publication 5001 discusses theory and problem of cold water clarification as well as advantages of applications and various designs. Auxiliary and supplemental apparatus are described.

6 LOADING ARM

Chiksan Co.—Four-page bulletin 1055-A covers hydraulically controlled marine loading arms and shows operational advantage enabling one man at a remote control point to place flange end of 8 or 10 in. aluminum loading arm aboard largest tanker. Eight-in. arm operates from 220/440 v 3 hp motor, 7.5 gpm hydraulic pump.

7 STEEL FORGINGS

Drop Forging Assn.—"Metal Quality," a 60-page book, describes in detail the successive steps performed in making forgings. Charts, 200 illustrations show all phases of forging production, from steel making to the finished product.

8 MOLDED PACKINGS

Raybestos-Manhattan, Inc., Packing Div.—An eight-page bulletin features molded hydraulic and pneumatic packings including "Vee Flex" packing rings, self-sealing, self-adjusting packings for hydraulic and pneumatic equipment. Five types are available for pressures to 6000 psi and higher. Descriptive and size data is included on homogeneous V-ring and fabric piston cups.

9 TORQUE CONVERTERS

National Supply Co.—Bulletin No. 468 describes single-stage torque converters for heavy industrial service, discussing background, design, types, sizes, circuits and applications. It also contains a capacity chart of the six sizes and 17 input ratings. Data sheets give application and dimension data of each of the six sizes, with performance curves, capacity chart, important features and typical torque converter arrangements.

10 VACUUM PUMPS

Leiman Bros., Inc.—A 16-page catalog, No. 1957, describes rotary positive air and vacuum pumps, gas boosters and air motors. Included are 2 and 4 wing types; fan-cooled, water-cooled and new radiator air-cooled models; motor driven units; direct-coupled and belt driven models; integral pump and motor; automatically controlled tank units; accessories.

11 SPEED REDUCERS

Cleveland Worm and Gear Co.—Bulletin No. 145 provides 16 pages of illustrated summary information on the complete line of gear speed reducers.

DO YOU HAVE A TWO-STAGE PRESSURE OR TEMPERATURE CONTROL PROBLEM

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Mercoid DA-400 Series Controls are dual purpose controls (available for pressure or temperature) incorporating a single element operating two separate independently adjustable Mercoid magnetic mercury switches. Circuit arrangements can be supplied for various operations, a few examples are:

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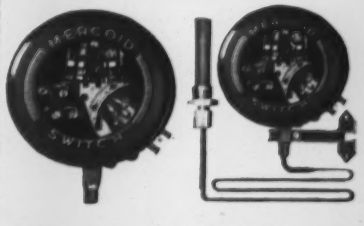
3. To provide two-stage control by opening one circuit on a rise and a second circuit on a further rise.

***Pressure types* available in 17 different operating ranges from 0-30" vac. to 300-2500 psi. *Temperature types* available in 11 operating ranges from -30-60°F. to 370-530°F.**



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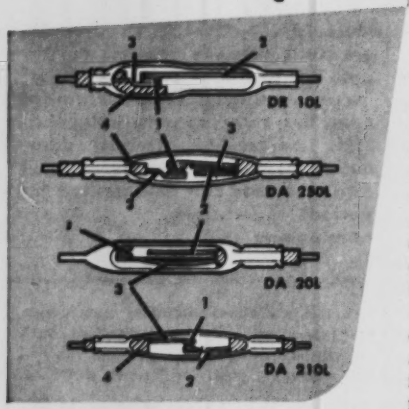
How CHACE Thermostatic Bimetal Actuates the FRANKLIN DALES Temp-Guard



The Temp-Guard is an extremely compact, self-contained and sealed tubular type circuit breaker manufactured by The Franklin Dales Co. Numerous variations of standard models are used in applications such as electric motors, operating on-off cycling systems, detecting fire and activating alarms, protecting electrical appliances, controlling regulating systems, automatically making or breaking current to solenoids, transformers, etc. The accuracy and dependability of this interesting device hinge upon its actuating element of Chace Thermostatic Bimetal.

The photo shows a typical Temp-Guard actual size. Others vary from 1 5/16" to 3 3/8" in length. The sectional drawings show four representative types of circuits; the DR models have the thermostatic bimetal element in contact with the case; the DA models have element insulated from the case. The numeral "2" indicates that case does not carry current. Parts numbered in the drawings are:

1. Contacts
2. Thermostatic Bimetal Element
3. Conductive Strip
4. Insulation

In all examples, the bimetal element deflects in response to changes in ambient temperature or heating of the element due to overload, making or breaking the circuit.

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YOUR New Catalogs GUIDE

12 BLAST CLEANING UNITS

Pangborn Corp.—"Blastmaster Rotoblast Barrels" describes airless blast cleaning equipment. It illustrates from 1½ cu ft capacity to 27 cu ft. Dimensions and description of how the units work and sections on an abrading unit, an abrasive reconditioning system, construction features and the barrel's adaptation to automation are included.

13 DRAFT GAGES INSTRUMENTS

Ellison Draft Gage Co., Inc.—Bulletin 354-A gives a briefing on the entire line of the company's bell actuated and diafram actuated draft gages, inclined tube draft gages, pitot tubes, gas analyzers, steam calorimeters and other boiler room and laboratory gages and instruments.

14 COMPRESSOR VALVES

J.H.H. Voss Co.—Bulletin 53-G covers valves for air, gas or ammonia compressors. The valves are machined from solid stock; plates are machined and ground; valves and plates are of heat treated alloy or stainless steel and are specially designed to fit the individual characteristics of the compressor for which they are manufactured.

15 PROCESS PUMPS

Peerless Pump Div., Food Machinery & Chemical Corp.—A 110-page catalog No. B-127, describes and illustrates line of horizontal and vertical pumps for water and process liquid handling in municipal, industrial and commercial applications. Catalog includes 20-page section of engineering information, data determinants and formulas.

16 PIPE FABRICATION

Dravo Corp., Machinery Div.—Bulletin 1704 illustrates a part of the firm's record of engineering construction of pipeline pumping and compressor stations for the transmission and storage of gas and petroleum products.

17 TABLE PULVERIZER

Foster Wheeler Corp.—The new type BM planetary roll and table pulverizer is described in four-page Bulletin MB-55-5. Included are description, operation, cross-section and detail photographs, dimensions and capacities of the ten sizes available.

18 FLUID DRIVES

American Blower—Bulletin A-119 describes Class 2 Gyrol fluid drive. Speed control, power savings, no-load starting, torque limitation, acceleration control, shock absorption and simplified installation are itemized. Selection guide tables for both variable and constant torque loads indicate proper size to use with drive motors rated from 7.5 to 800 hp.

19 ANALOG-DIGITAL CONVERTERS

Librascope, Inc.—A six-page folder shows specifications and illustrations of converters which transfer data from shaft to code disks where non-ambiguous double brush pick-offs direct it to scan a network. Models cover 7 to 19 digits.

20 LEADED STEEL

Alco Products, Inc.—An eight-page illustrated bulletin covers new Hi-Qua-Led leaded steel in all steel grades in forged and rolled rings from 18 to 145 in. OD. New lead addition method is said to produce steel suitable for most rigid forging and machining applications.

21 PIPE COUPLER

John Bean Div., Food Machinery & Chemical Corp.—A folder illustrates and describes a fast move industrial coupler designed for use with any make of portable aluminum pipe for transporting brine, natural gas, crude oil, butane, water and other liquids for the petroleum, chemical, mining and construction industries.

22 PLUG VALVES

Ohio Injector Co.—A 24-page valve comparison chart covers line of bronze, iron, forged steel, cast steel, and lubricated plug valves; has abbreviations key and handy numerical listing of all valves; cross references figure numbers of all valve manufacturers with similar valves.

YOUR *New Catalogs* GUIDE

23 HOT WATER BOILERS

Combustion Engineering, Inc.—A 20-page brochure describes and illustrates the design, construction, advantages and economies of La Mont controlled circulation hot water boiler for supplying high pressure, high temperature water for heating systems and process applications.

24 METALS

Meehanite Metal Corp.—Bulletin 32, contains a tabular summary of the physical properties of the various types of metals. These properties are said to provide a dependable material of construction and are the result of the controlled manufacture and the adjustment of the physical constituents of the material in accordance with the requirements of the casting design.

25 VALVES, BOILER MOUNTINGS

Lunkenheimer Co.—A reference work contains new sections describing new LQ600 bronze globe valves with Brinalloy seats and discs; PVC all-molded valves which are completely resistant to industrial chemicals; and solder end valves. Also included are 24 pages of tables, technical data and information on the selection of valves, boiler mountings, and lubricating devices.

26 OIL SEALS

National Seal Div., Federal-Mogul-Bower Bearings, Inc.—Oil seal catalog illustrates complete line, gives types and sizes of leather and synthetic rubber oil seals, synthetic seals with metal or rubber covered outside diameters, contains design suggestions, drafting information, application data, and installation tips.

27 MATERIALS HANDLING

Syntron Co.—A condensed catalog, No. 564, contains 50 pages of technical data, brief description and photographs of bin vibrators, vibratory feeders, vibratory conveyors, power tools, shaft seals, selenium rectifiers, vibrating parts feeders, heating elements and other equipment.

28 VALVELESS FILTER

Permutit Co.—Bulletin No. 4351 describes the company's automatic gravity sand filter for municipal or industrial water treatment. The unit uses no valves, pumps, or flow controllers, and is said to cost less than conventional manual filters, reduce costs of installation, operation, maintenance and expansion, and produce uniform high-quality effluent. Sizes up to 400 gpm are available.

29 CENTRIFUGAL PUMPS

Nagle Pumps, Inc.—Bulletin CWO describes the firm's new line of Type CWO vertical shaft, centrifugal pumps for handling abrasive, corrosive or toxic mixtures and molten or fluid high temperature materials up to 1200 F. Pump shaft operates within a center column which is the supporting structure. All bearings are above floor level.

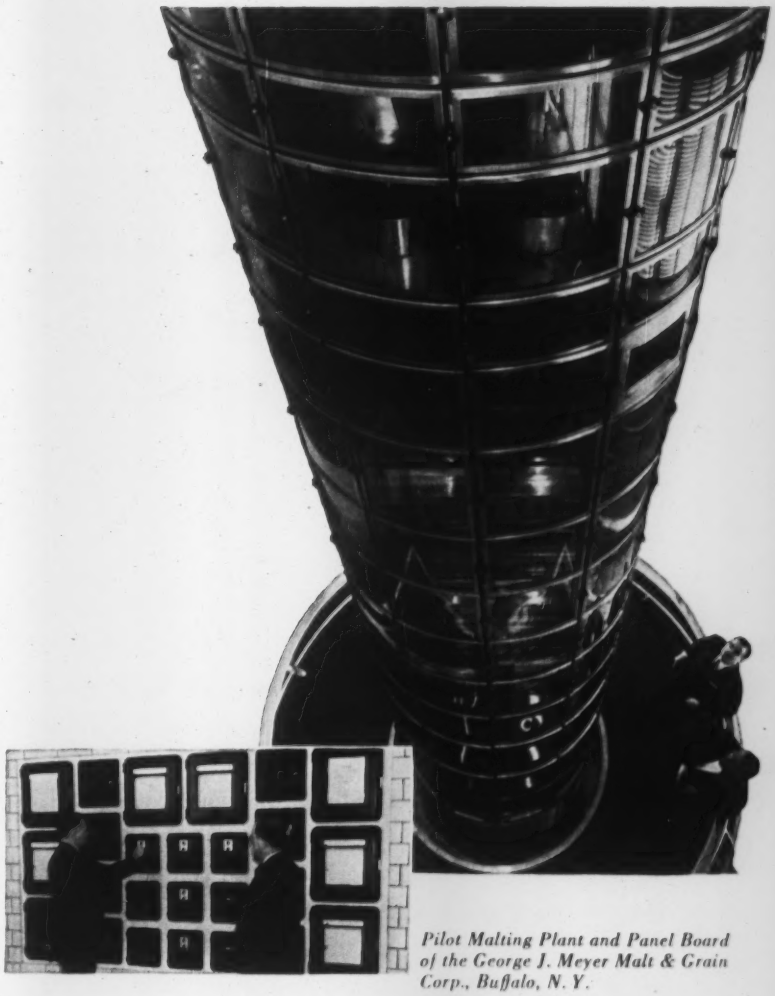
30 SPUN STEEL TUBING

American Cast Iron Pipe Co.—Photographically illustrated 64-page catalog describes special products division facilities, the centrifugal spinning process, its advantages, and illustrates versatility of application of Acipco steel tubes. It contains tables, technical data, engineering information designed for designers and users of steel tubes 2.25 – 50 in. OD.

31 BRASS MILL PRODUCTS

Bridgeport Brass Co.—A 250-page technical handbook on copper-base alloys covers strip, sheet, rod, wire, tube. Details on composition, mechanical and physical properties, suggested applications are included, along with photos, tables, charts.

A world of facts at your fingertips. Use coupon on page 42 for free catalogs you need.



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32 FRACTIONAL HP MOTORS

General Electric Co.—Bulletin GEC-1027 gives buying information on fractional horsepower general purpose and definite purpose motors and gear motors, and integral horsepower single-phase and polyphase motors and gear motors.

33 NEW SEMI-PRESSURE FANS

Aerovent Fan Co., Inc.—New "SP-7" semi-pressure fans, for efficient performance against static pressures normally considered above the range of propeller-type fans, are described and illustrated in Bulletin 400. They are available in direct-connected, direct-driven duct, belt-driven duct, "Bi-Flo" duct and extended-shaft types, sizes 14 to 60 in. diam, all with new, broader seven-blade "Macheta" air-foil propellers.

34 GLASS-BONDED MICA

Mycalex Corp. of America—A revised engineering data file, contain technical information, design considerations and suggested applications of the company's Supramica ceramoplastic and Mycalex glass-bonded mica products. Charts of electrical and thermal characteristics and tabular data on the physical properties of the materials are included.

35 HEAVY DUTY COMPRESSORS

Pennsylvania Pump & Compressor Co.—Single stage, horizontal, water cooled, heavy duty air compressors in sizes from 10 to 125 hp and for pressures to 150 psig covered in Bulletin 201-E.

36 STORAGE TANKS

W. E. Caldwell Co.—A 48-page catalog, No. 65, contains technical data, illustrations and price information covering metal and wood tanks with mechanical equipment and other accessories. Included are elevated and ground storage tanks, field erected, and shop built pressure and vented tanks.

37 STEAM GENERATORS

Ames Iron Wks., Inc.—Bulletin GB-1 describes how generators have helped solve boiler room problems. The advantages of compact, simple and efficient design of complete packaged boilers are shown being put to use in plants across the nation.

38 FLEXIBLE SEAL

New Departure Div., General Motors Corp.—A folder illustrates and describes the sentriseal, a new type of flexible seal available on a large variety of standard dimension ball bearings. This seal, which is available on a series of adapter bearings makes it possible to relubricate where desired, without removing the seals. Seals are easily removed if required.

39 PROPORTIONING PUMPS

Hills-McCanna Co.—A two-color, eight-page catalog, No. 602, covers details and specifications of the Model U and K mechanical and hydraulic drive metering and proportioning pumps, the Hills-McCannameter for precision pumping as low as 11 cc/min and the new Model 4411 chemical pump for systems requiring limited capacities.

40 LUBRICATION EQUIPMENT

Universal Lubricating Systems, Inc.—A catalog covers air couplers, ball swivels, buttonhead couplers and fittings, drain plugs, flush type fittings, grease fittings, hose and guns, hose adapters, needle type adapters, swivel couplers.

41 VIBRATION CONTROL

MB Mfg. Co.—A 12-page catalog illustrates, describes and gives specifications on vibration isolators, engine mounts, vibration test equipment and vibration control engineering. Included is an isomode design chart to assist in finding mounting points for any product design.

42 MULTI-STAGE TURBINES

Murray Iron Works Co.—Bulletin T-122 illustrates and describes multi-stage turbines for mechanical drive. The turbines are designed for a wide range of capacities and for operation with steam conditions of up to 600 lb, 750 F, and exhaust pressures from condensing to 75 psig.

43 DRAFTING SYSTEM

Universal Drafting Machine Corp.—Literature covers a new portable drafting system, consisting

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of a personal size professional drafting machine folding drawing board, metal scales, instrument box and travel case, which can be set up on a desk in two minutes. The system, called Desk-Topper, is designed for use at home, in the office or hotel room, or on planes or trains.

44 PLASTIC PIPE FITTINGS

Grinnell Co.—A 12-page catalog on corrosion resistant pipe fittings and flanges in normal impact grade and high impact grade, rigid, unplasticized polyvinyl chloride shows characteristics, advantages and limitations. Listed are operating pressures, temperatures, applications, price comparisons, fabrication advice, installation and supporting recommendations, dimensions and weights.

45 DRAFTING ROOM EQUIPMENT

Hamilton Mfg. Co.—Catalog No. 14 lists steel and wood drawing tables and files for every drafting room need. It includes comprehensive data on the Auto-Shift drafting table, and information about the shallow-drawer unit with tracing lifter.

46 HYDRAULIC PULSATION DAMPENER

Westinghouse Air Brake Co.—A four-page catalog illustrates and describes a device that suppresses the pulsations and pressure surges which reciprocating pumps, centrifugal pumps and quick closing valves introduce into hydraulic systems.

47 TEMPERATURE CONTROLS

Fenwal Inc.—Detailed folders describe devices for temperature detection, indication and control. Included are Thermoswitch and snap action local controls, remote bulb and capillary units, Detect-a-Fire and electronic thermistor controllers.

48 PIPELINE FITTING DEVELOPMENTS

Ladish Co.—A 21-page manual provides data on five fittings developments for pipeline and petroleum industry applications. The developments concern hot tap reinforcing tees, multiple outlet fittings, extra long radius elbows, pipeline anchor flanges, seamless multiple outlet fittings.

49 WORM GEAR JACK

Duff-Norton Co.—An 8-page manual illustrates applications of the company's worm gear jack for raising and lowering movable parts in metal-working machinery. Included are the elevation of mill tables, rolls, conveyors, machine beds.

50 FLOW TRANSMITTER

Foxboro Co.—Bulletin 13-11 describes advanced design Type 13A d/p cell transmitter designed for all types of flow and liquid level measurements. Bulletin 20-14 explains the firm's magnetic flow meter for difficult fluids, and Bulletin 13-23 covers a new linear, pneumatic flow integrator.

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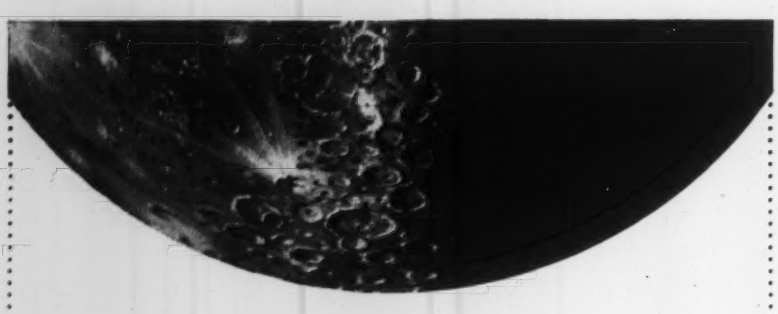

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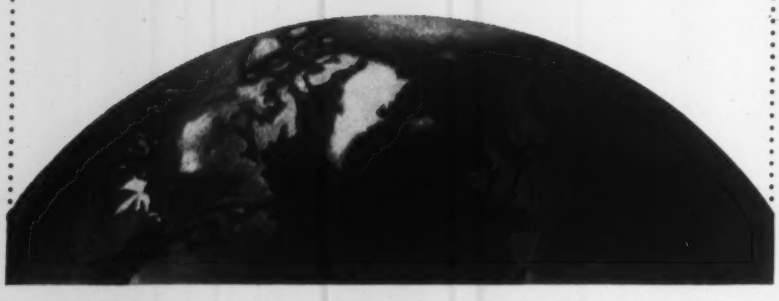

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51 CONSTANT-FORCE SPRING

Hunter Spring Co.—A 16-page catalog describes the Neg'ator spring, a long extension, constant-force spring said to offer an entirely new approach to mechanical design problems involving tension, pressure, motion. Bulletin details forms, characteristics and applications.

52 TEST BOILERS

Besler Corp.—A four-page folder covers features and advantages of high temperature, high pressure test boilers, designed to deliver steam up to 3000 psi and 1100 F. Units deliver steam within several minutes from cold start. One of the models handles loads from 500 to 15,000 lb-hr.

53 REDUCING VALVE

Leslie Co.—Bulletin 561 describes new reducing valve for steam heat and process steam applications sizes 1/2 to 2 in., inlet pressures 0–250 psi, 450 F, reduced pressures up to 249 1/2 psi, made of cast iron with screwed end connections. Capacity-regulation data is included.

54 SPEED REDUCERS

Falk Corp.—Bulletin 1105 combines in one book technical information on the company's lines of small concentric shaft and right angle speed reducers for applications up to 138 hp.

55 ALUMINUM ALLOYS

Aluminum Co. of America—A hard cover book contains data on aluminum alloys and mill products in tabular form. Information is given as reference for those responsible for planning, designing, testing, purchasing, and fabricating aluminum successfully.

56 AIR PREHEATERS

Air Preheater Corp.—How the Ljungstrom air preheater saves fuel, while improving performance of boilers, is told in 38-page bulletin. It gives structural details of the unit, how to modernize old installations, industrial uses, arrangements, specifications and suggests additional uses.

57 DATA PROCESSING

Consolidated Electrodynamics Corp.—A 32-page general catalog, No. 1305, describes recording oscillographs and amplifying systems, direct writing oscillographs, vibration pickups, pressure pickups, magnetic tape systems, analog-to-digital conversion systems, and analytical and process control instruments including mass spectrometers, chromatographs, refractometers, leak detectors and sulphur monitors.

58 STEAM, HOT WATER GENERATORS

Cyclotherm Div., National-U.S. Radiator Corp.—Cyclonic combustion is described and illustrated in this new bulletin, which details package-boiler process for transferring 65 to 70 per cent of fuel heat energy in combustion chamber. Cyclotherm is guaranteed to operate at minimum of 80 per cent efficiency with two passes. Bulletin also contains ratings and dimensions, general specifications.

59 PLUG VALVES

DeZurik Corp.—A 36-page catalog covers eccentric plug valves. It explains eccentric action principle, and describes 1/2 through 20 in. valves and accessories, pneumatic, hydraulic and electric operators, pipe line strainers, and indicates service recommendations for valves. Valves are illustrated and dimensions are listed with flow charts.

60 CENTRALIZED LUBRICATION

Farval Corp.—An illustrated brochure, Bulletin No. 26, offers 20 pages of material relating to centralized systems of lubrication. The booklet discusses principles of operation, product advantages and system components.

61 TIMING BELT

United States Rubber Co., Mechanical Goods Div.—A set of manuals illustrate and describe, with drive tables, the PowerGrip timing belt. This drive is said to assure tooth-grip precision, and for power transmission its steel cable tension member provides horsepower that ranges from 1/100 to 600 and up, without stretch.

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62 ROTARY STEAM JOINTS

Seamlex Co. Inc.—Bulletin 5500-A describes rotary joints with triple protection against leakage. Principal features described include external screw adjustment, floating rotary seal, pressure-equalizing chamber. The unit conveys steam, water, air and other fluids, and is made in syphon and through-flow type, pipe sizes $^1/_4$ to 2 in.

63 DIESEL ENGINES

Nordberg Mfg. Co.—Two-cycle $21^1/_2$-in. bore diesel and Duafuel engines are described in a 20-page bulletin. Operating advantages and overall economy features of Type TS-21 engine are outlined. Details are given on the firm's experience with heavy fuel oils and two-cycle dual fuel operation.

64 GAS-FIRED HEATERS

Reznor Mfg. Co.—Bulletin GN-57 gives specifications, dimensions and application and installation information on gas-fired unit heaters and duct furnaces. Capacities on unit heaters range from 25,000 to 250,000 Btu. Individual unit capacities for duct furnaces range from 50,000 to 300,000 Btu; system capacities in excess of 2,000,000 Btu are obtainable through sectional assembly.

65 MECHANICAL-OPTICAL FACILITIES

Kollmorgen Optical Corp.—Bulletin 500 describes facilities for precision mechanical and optical manufacturing. It includes engineering and inspection equipment, plus narrative outlining company's activities in the fields of atomic energy, nuclear research and remote observation, with emphasis on industrial periscopes of which it is a prime supplier for government and commercial use.

66 PACKAGED BOILER

Preferred Utilities Mfg. Corp.—A six-page booklet illustrates and describes the design, construction and application of "Thermopak" factory-assembled, automatic oil, gas or combination fuel burning system for old or new boilers. The system's components, accessories, and piping layouts are itemized.

67 LOW NPSH PUMPS

Roy E. Roth Co.—An eight-page illustrated bulletin describes newly developed Low NPSH turbine pumps for heads to 1600 ft, capacities to 100 gpm, requiring 1 to 3 ft NPSH. Performance; mechanical and dimensional data are included. The pumps are specifically designed for LPG; refrigerants; chemical process handling clear, boiling liquids; boiler feed service. They are available in special metals for corrosive service.

68 PROPELLER FANS

Buffalo Forge Co.—Bulletin 1234, a 16-page picture book, shows a variety of direct connected and belt-driven propeller fans in sizes up to 144 in. diam. Numerous applications are listed.

69 COPPER, COPPER ALLOYS

Revere Copper & Brass Inc.—"Technical Information on Revere Copper and Copper Alloys," 48 pages, discusses the advantages, compositions, physical properties, ASTM and SAE specifications of copper and copper alloys, as well as welding techniques.

70 INDUSTRIAL LIQUID METERS

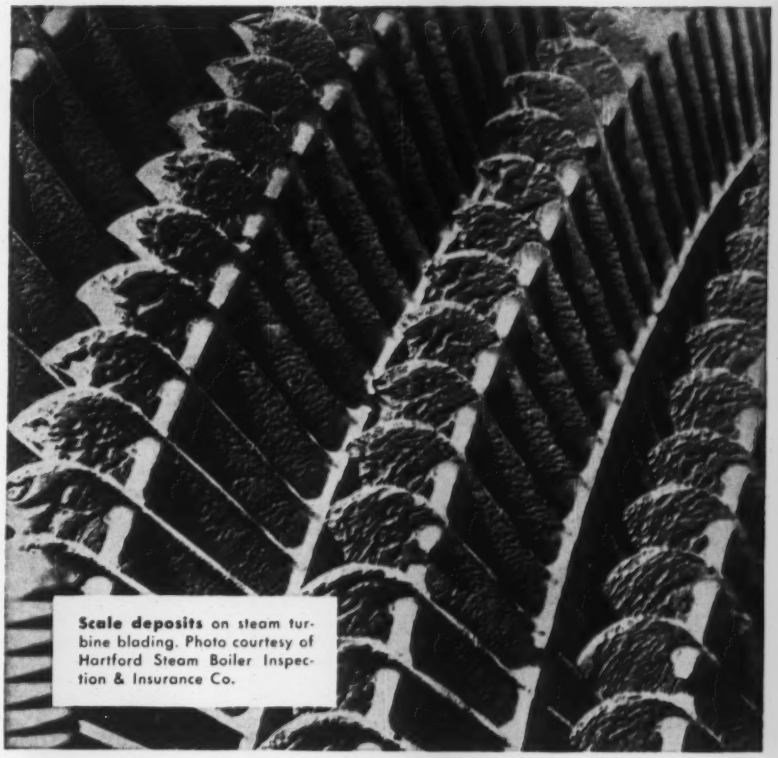
Neptune Meter Co.—A 28-page liquid meter bulletin, No. 566, contains selector charts which tell how to pick the right meter and register for more than 150 typical liquids. It describes the firm's Auto-Stop, repeating Auto-Stop, ticket-printing features and electric Auto-Switch for operating pumps.

71 FEEDWATER HEATERS

Ross Heat Exchanger Div., American-Standard—Bulletin 5.6K1, four pages, describes high pressure closures for feedwater heaters and other high pressure, high temperature exchangers. Design details are illustrated by photos and cross sections. Text discusses simplicity of design, safety factor, and ease of removal.

72 WATER COOLING TOWERS

Marley Co.—A four-page bulletin, No. G-56, contains illustrations and descriptions of water cooling towers for industrial, refrigeration and air conditioning application. Other bulletins describing specific types of cooling towers are listed by num-



Scale deposits on steam turbine blading. Photo courtesy of Hartford Steam Boiler Inspection & Insurance Co.

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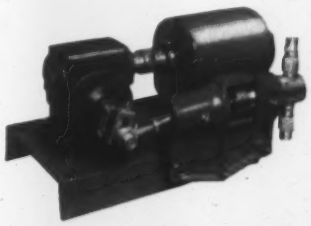

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ber. A condensed description of cooling tower wood preservative methods, exclusive processes is included.

73 PROCESS INSTRUMENTATION

Fischer & Porter Co.—A 32-page catalog describes the company's products available for immediate shipment. Included are prices. It covers indicating, recording, controlling and transmitting instruments for flow, pressure and density.

74 STOOLS, CHAIRS

Cramer Posture Chair Co.—A brochure illustrates different models of stools and posture chairs. Engineering drawings and photographs show exclusive forward tilt, adjustable footring, finger-tip adjustments and foldaway back.

75 STEAM TRAPS

V. D. Anderson Co.—Bulletin No. 154 contains specifications, capacities, sizes, pressures, weights and list prices of all principal types of Super-Silvertop traps. Construction and operating information is also included. Contains buying information on Anderson self-cleaning strainers and high-pressure steel series steam trap.

76 GATE, GLOBE VALVES

Wm. Powell Co.—A 24-page condensed catalog illustrates and describes gate, globe, angle, check, Y, flush bottom tank, lubricated plug, valves in bronze, iron, steel and corrosion-resistant metals and alloys. It lists available sizes and pressure-temperature ratings.

77 FLUID COOLERS

Trane Co.—Bulletin S-395, eight pages, discusses features of air cooled heat exchangers to cool liquids and gases, condense vapors, covers operational features, models, range of sizes, installation versatility, component parts, and extended surface heat transfer surface construction.

78 FORGINGS

Kropp Forge Co.—A 40-page brochure describing the personnel, facilities and products of this company contains photographic coverage of research, die making, forging, heat treating and machining operations for the production of close-to-tolerance forged parts. Included is information on standard forging practices, tolerances and procedures.

79 PNEUMATIC CONVEYORS

Dracco Corp.—A 32-page bulletin gives technical information and data on automatic bulk materials handling with Airstream conveyors. Functions, materials handled, components, methods of integration and control and cost-saving solutions to handling problems in many industries are discussed and illustrated.

80 COPPER, COPPER ALLOY

American Brass Co.—A 24-page reference manual contains copper and copper-alloy specifications, including ASTM, ASME, AWS, SAE, AMS, federal, military, Army, Navy, and joint Army-Navy specifications.

81 ADJUSTABLE PIPE HANGERS

Blaw-Knox Co., Power Piping and Sprinkler Div.—New 100-page Catalog 54 features the Blaw-Knox functional spring hangers, vibration eliminators, and overhead roller assemblies. The improving and simplifying of complicated piping systems is explained by charts and drawings. A Technical Section enables a piping engineer to solve most hanger load problems and thus determine the hanger requirements for the particular piping under consideration.

82 TORQUE MANUAL

P. A. Sturtevant Co.—A 28-page torque manual, second edition, illustrates application ideas, tabulates torque and tension relationships for both mild steel and high tensile steel bolts and shows screw torsional strength recommendations. Included are illustrations of adaptor and attachment ideas and formulas for using these correctly with torque wrenches.

83 INDUSTRIAL COOLING FANS

Koppers Company, Inc., Metal Products Div.—A 4-page folder illustrates and describes new, all-metal Aeromaster fans for cooling towers and radiator-type coolers. Design features are discussed. A 4-page folder on precision-engineered air delivery is also available.

84 DRAFTING DESK

General Fireproofing Co.—A folder illustrates and describes a drafting desk which has a belt positioning control and incorporates a reference area and storage space in one compact unit.

85 GAGES AND THERMOMETERS

Marsh Instrument Co.—Catalogs No. 76-G and 76-T describe in detail a wide line of industrial gages, needle valves and thermometers. The catalogs are fully illustrated, including cut-away photographs and enlargements of internal parts. They cover also gage accessories, specifications including line drawings and dimensional tables, and templates covering every size and pattern.

86 DEMINERALIZATION

Graver Water Conditioning Co.—Bulletin WC-111, 22 pages, covers chemical and mechanical factors entering into the design and operation of demineralizing plants for obtaining the highest quality process water and boiler feedwater from a wide range of water supplies under many different operating conditions.

87 SPECIAL STEELS

Allegheny Ludlum Steel Corp.—A 16-page booklet gives details on stainless steels, electrical materials, Carmet carbide materials and tool steels. Charts give analysis of various steels, and information on fabrication properties is included in the booklet.

88 FLY ASH INTAKE VALVE

United Conveyor Corp.—Four-page bulletin 1-1-55 gives information on various stages of development and design of feeding inlet and intake valve for operation with pneumatic fly ash conveyors. It describes application for manual and automatic operation and lists features of present-day design.

89 MOTOR SPEED CONTROLS

General Radio Co.—An 8-page booklet contains characteristics, photographs, applications, and prices of line of Variac motor speed controls. Models from $^1/_{16}$ to $1^1/_2$ hp are available.

90 COUPLINGS

Snap-Tite, Inc.—Four bulletins and various data sheets cover couplings for high pressure systems, gravity flow systems, vacuum systems and hydraulic systems. Cutaway photos, diagrams and flow charts are included in the literature.

91 HEAT EXCHANGERS

Alco Products, Inc.—Bulletin FH-3 illustrates and describes Alcotwin in tube heat exchangers. Dimensions, mechanical specifications, and charts of finside coefficient and finside pressure drop for all sizes are included.

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92 HIGH-STRENGTH STEEL

Jones & Laughlin Steel Corp.—A booklet presents Jalten, a versatile low-alloy high-strength steel said to have light weight, abrasion and corrosion resistance and easy weldability. Application data is illustrated and described and tables show specifications.

93 OIL-RETAINING BEARINGS

Bound Brook Oil-Less Bearing Co.—More than 600 of the most widely used sizes of oil-retaining porous bronze bearings are listed in the firm's Stock List No. 4. Also provided is condensed information on application, installation, lubrication and machining.

94 CENTER GUIDED CHECK VALVE

Miller Valve Co. Inc.—An eight-page bulletin illustrates and describes the Streamflow center guided check valve, said to be silent and shockproof, and which can be installed vertically or horizontally. Specifications and dimensions are tabled.

95 VIBRATION ISOLATORS

Barry Controls, Inc.—Standard and special mounts for shock, vibration and noise control in airborne, shipboard, and vehicular installations as well as industrial machines are described in 4-page catalog keyed to supply detailed information by reference numbers. Also offers service facilities of representatives for development, test and application of vibration control.

96 WELDING

Lincoln Electric Co.—"Design Ideas" is a series of pamphlets issued periodically to design engineers, production men, and management executives. Current series outlines fundamentals of how to design with steel, to reduce costs and improve performance, with special charts and checking information.

97 PRESSURE GAGES

American Chain & Cable Co., Helicoid Gage Div.—The 24-page Helicoid gage catalog describes the Helicoid gage as guaranteed accurate to within $\frac{1}{2}$ of 1 per cent of the total dial graduation over the upper 95 per cent of the 270-deg dial arc. Cutaway photographs and line drawings show the complete line of Helicoid gages.

98 POLYVINYL PIPE

National Tube Div., U.S. Steel Corp.—Bulletin 24 gives properties and specifications of both high-impact and normal impact polyvinyl chloride pipe. A section covers installation procedures. The chemical resistance of the plastic pipe is compared with pipe of other materials.

99 DRAWING INKS

Higgins Ink Co.—A brochure describes the firm's line of drawing inks, India inks, waterproof colored inks, art books, accessories, pen cleaner and ink assortments. Also included is a section on how to dilute inks and clean pens.

100 HARD CARBIDES

Kennametal, Inc.—A 44-page booklet describes basic design principles for use of hard carbides; methods of forming; methods of fastening carbides mechanically; and a general treatise of Kennametal and suggested fields of application.

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Installing a BS&B Rupture Disc on a pressured system provides protective insurance against a major disaster. Thousands of BS&B Safety Heads, each containing a BS&B Rupture Disc custom made to meet the individual requirements of the system it protects, are now guarding pressured systems in all types of industries.

Fully accepted by most local and national codes for use as either primary or secondary pressure relieving devices, BS&B Rupture Discs can be *your* positive and final measure of protection for the unexpected emergency.

THE "CIRCUIT BREAKER" of Pressured Systems

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Refrigeration Serves Big Armour Laboratories

Armour and Co. use "cold" in many ways in their great Pharmaceutical Laboratories, recently opened near Kankakee, Ill. These uses include air conditioning, biological process work, cold storage, heat-pump service, and research.

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Here a 2-stage Frick system of 1422 tons refrigerating capacity operates with efficiency and economy. Installation by Midwest Engineering and Equipment Co., Frick Sales-Representatives in Chicago.

Four of eight ammonia compressors furnishing refrigeration at temperatures down to −45° F.

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It takes exceptional pumps to feed the most powerful propulsive system ever built—the Large Rocket Engine. And it creates an exceptional career for the man who develops these pumps.

Rocket Engineering offers the most interesting opportunities in the pump engineering field today. Your experience with commercial pumps and compressors will be extremely useful—to help solve problems of head capacity, power and speed never before encountered. You'll gain technical and professional experience that is unobtainable elsewhere... your contributions to the advanced techniques of pump design will be recognized and rewarded.

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If you are an experienced pump engineer with the ambition to break new ground, tell us about yourself. Chances are, your creative ability can open up a new career for you in Rocket Engineering—more fascinating and more valuable to you than the work you are now doing. Write: Mr. A. W. Jamieson, Rocketdyne Engineering Personnel Dept. ME-4, 6633 Canoga Avenue, Canoga Park, California.

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A DIVISION OF NORTH AMERICAN AVIATION, INC.

BUILDERS OF POWER FOR OUTER SPACE

YOUR *New Catalogs* GUIDE

101 ELECTRIC HEATING UNITS

Edwin L. Wiegand Co.—Catalog 50 covers specifications, construction details, application data, and prices of their complete line of electric heating units. Models are available with strip, ring, tubular, and cartridge heating elements. Also described are immersion, circulation, radiant, and forced-air duct heaters. Charts and tables are provided.

102 PIPE FITTINGS, FLANGES, VALVES

Tube Turns Plastics, Inc.—Unplasticized polyvinyl chloride pipe fittings, flanges and valves are the subject of a new booklet. It discusses industrial applications of PVC piping and gives complete specifications for threaded and socket type of fittings and flanges, in both normal and high impact grades.

103 CLEANABLE FILTERS

Cuno Engineering Corp.—Literature covers Auto-Klean and Super Auto-Klean edge-type cleanable filters, and filters for built-in installations.

104 STEEL RESERVOIRS

L. O. Koven & Brother, Inc.—Bulletin No. 555 illustrates and describes steel reservoirs and standpipes for water storage from 50,000 to 2,500,000 gal for municipal and private water distribution systems. Representative sizes are listed.

105 FORCE GAGE

W. C. Dillon & Co.—A six-page bulletin illustrates and describes a mechanical force gage designed to measure mechanical forces in either compression or tensile in limited space. Ranges 0-10 up to 0-50,000 lb with accuracy of within 1 per cent.

106 REPRODUCTION MATERIALS

Eastman Kodak Co.—All materials available for preparation and reproduction of drawings and documents described in a booklet. A selection chart which matches originals to be reproduced with the recommended materials is included.

107 EXPANSION-JOINT DESIGN GUIDE

Flexonics Corp.—A 24-page Flexon Expansion Joint Design Guide, Catalog 160, covers engineering application and selection data necessary to the proper solution of pipeline expansion problems. Features of the Flexon Design Guide include a discussion of the various types of expansion joints on the market, the many types of Flexon Expansion Joints available, and types of pipeline motion solved by expansion joints; also expansion joint design considerations, installation instructions, and selection data. The new line of Model H compensators is completely covered. The center spread of the catalog is devoted to a schematic piping layout illustrating various expansion joint applications and principles.

108 O-RINGS

Linear Inc.—Compact 12-page folder contains tables of standard O-ring sizes as well as dimensional data for installation. Notes contain general recommendations on clearances, design material, machining, and finishes for most O-ring applications. A special compound bulletin describing the latest polymers and synthetic rubbers from which O-rings can be molded is also included.

109 WATER SOFTENER

Cochrane Corp.—A bulletin covers the firm's hot lime-zeolite softeners. Methods of operation, expected results, chemical savings and simplicity of operation are described in the bulletin, designated Publication 4801-A.

110 ROTARY ELECTRICAL UNITS

Western Gear Corp., Electric Products Div.—Bulletin 254-A contains specifications and diagrams of the firm's permanent magnet and wound field d-c motors, a-c motors with and without gear reduction, a-c/d-c generators, motor and fan assemblies, axial flow blower assemblies, centrifugal blower assemblies.

111 LIMIT SWITCHES

National Acme Co.—Bulletin EM-51 covers the firm's line of heavy duty limit switches designed to meet severe mechanical and electrical conditions imposed by heavy duty machine tools. EM-5512 illustrates a new single pole, double make, double break snap-action series of switches and EM-5524 illustrates a double pole, double throw, quick make-quick break series.

YOUR

New Catalogs GUIDE

112 ADJUSTABLE SPEED DRIVE

Dynamatic Div., Eaton Mfg. Co.—Bulletin FAS5 illustrates and describes the firm's fractional horsepower Ajusto-Spede drive. Fundamentals of operation, capacities, mechanical construction, optional features and controls are covered.

113 CURRENT COLLECTORS

Morganite, Inc.—A 4-page folder illustrates and describes carbon current collectors. Three main types are shown for crane applications.

114 VIBRATION ISOLATION

Korfund Co.—A four-page bulletin gives information on how to write vibration isolation specifications for air conditioning and related equipment. It contains a definitive treatment of the factors involved in the selection of various isolation media commercially available and has a selector chart designed to simplify writing specifications.

115 TAPERED ROLLER BEARINGS

Timken Roller Bearing Co.—An eight-page folder describes the four new tapered roller bearings along with auxiliary parts that have been developed to provide customers with lower cost bearing applications without sacrificing the long life and minimum maintenance expected.

116 NEW METHOD OF LUBRICATION

Stewart-Warner Corp., Alemite Div.—Catalog describes new method of lubricating industrial machinery with "Oil-Mist." Bulk of publication taken up with engineering data, covering applications, operation, bearing application, bearing speeds of this method. Also for plain bearings, selection of condensing fittings, intermixing of condensers, bearing grooving and many other engineering data appropriate to the subject.

117 OSCILLOSCOPES

Allen B. DuMont Laboratories—Catalog No. 754, 100 pages, contains data on cathode ray oscilloscopes and associated test equipment including pulse generators, sine-wave generators, electronic switches, photographic recording equipment, etc.

118 DISASTER RECOVERY

General Electric Co.—A 12-page publication "When Disaster Strikes," designated GEA-6484, tells how the firm's apparatus service shops can help speed plant recovery following emergencies. The bulletin describes procedures for the recovery of vital electrical equipment damaged by flood, fire, water, wind. The suggestions serve as a guide in helping industries and utilities resume production quickly—prior to contacting the service shop for assistance.

119 DRAFTING MACHINES, INSTRUMENTS

V. & E. Mfg. Co.—16-page booklet describes and illustrates Vemco drafting machine, plus vertical and detail models and various scales. 20-page booklet covers company's line of drawing instruments and materials.

120 SPEED VARIATOR

Cleveland Worm & Gear Co.—Bulletin K-200 illustrates and describes a speed variator that provides indefinitely variable output speed over a range up to 9:1 from a constant speed power source. Operating characteristics, diagrams and cutaway drawings are included.

121 CAST, FORGED VALVES

Edward Valves, Inc.—Condensed Catalog 105 contains data on cast and forged steel valves for a variety of applications in boiler rooms, petroleum service, industrial and technological plants. Included are Rockwell-built Mudwonder mudline valves designed primarily for mudlines in oil fields but also suitable for abrasive fluid application in industry.

122 MINIATURE BALL BEARINGS

Miniature Precision Bearing, Inc.—A new 24-page, 3-color catalog, illustrated with comprehensive specifications on more than 500 types and sizes of standard miniature ball bearings from 1 1/2 mm to 3/8 in. OD, includes material of particular interest to designers of precision mechanisms—applications, lubrication, design variations, special bearings, etc.

This is an actual photo of a surface prepared by polishing and etching a cross-section of a forging, to reveal the "grain flow." (x2)

A PICTURE OF ADVANTAGES YOU CAN GET ONLY FROM FORGINGS

In the picture above you see the grain flow in a forging.

This picture demonstrates two things. First, the metal is dense and free from porosity. The impact or pressure of forging helps make it so. Such density is important when parts must have machined surfaces, when they must provide reliable strength and safety, and when they must be tight against leakage of liquids or gases. This quality reduces rejects and saves money. It contributes to safety and saves lives.

Second, notice how grain flow lines follow the shape of the part. This improves impact resistance and fatigue strength of the part. In closed-die forging, these flow lines can be positioned, to give maximum properties where they are needed. As a result, forged parts can be lighter, safer, stronger, and frequently less costly.

Thus this picture shows you why forged metal is *metal you can trust*. You can trust forgings for performance, and to save money. Find out how forgings can improve your products, your costs. Consult a *Forging Engineer*, and send for the booklets offered below.

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Power Take-Offs

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Export Sales Borg-Warner International — 36 So. Wabash, Chicago 3, Ill.

ENGINEERING B-W PRODUCTION

CLUTCHES

YOUR *New Catalogs* GUIDE

123 AIR CONDITIONER

Warren Webster & Co.—Bulletin B-2020, an 8-page illustrated booklet, describes new air conditioner for year-round heating and cooling. Heating coil connects to existing steam or hot water system. Self-contained, air-cooled, hermetic refrigeration cycle provides cooling and dehumidification. Bulletin gives construction details, unit ratings, dimensions and specifications.

124 VARIABLE SPEED DRIVES

Sterling Electric Motors, Inc.—An 8-page bulletin illustrates and describes variable speed drives for metal working, mixing, pumping, materials handling and continuous processing. Engineering selection and operating data is included. Also available is a revised price sheet.

125 ALLOY STEELS

Bethlehem Steel Co.—A 36-page booklet contains 20 brief articles on elements, grain size, heat-treatment, quenching media, depth-hardness, and other pertinent topics; also several pages of tables on standard alloy steels, tentative standard steels, boron steels, H-steels.

126 ROLLER CHAINS

Diamond Chain Co., Inc.—Catalog 758 contains information on stock roller chains and sprockets. Selection of stock drives, calculation of chain lengths, installation recommendations, and speed ratio tables are some of the subjects covered in the 64-page catalog.

127 GAGES

Manning, Maxwell & Moore, Inc.—A 128-page catalog describes the company's line of Duragages, quality, drawn case, chemical, chemical attachments, special application, navy and marine, laboratory and pocket test, Mercury column pressure and vacuum gages.

128 CORRUGATED ROOFING, SIDING

Philip Carey Mfg. Co.—Form 6300 illustrates corrugated asbestos-cement roofing and siding composed of Portland cement and asbestos fibres combined under pressure to form a homogeneous, monolithic sheet. The material is highly resistant to fire, acid and alkali fumes, salt air, rot proof and rodent proof. It never needs painting, but can be painted. Because deep corrugations provide beautiful shadow effects, it is often used for decorative purposes, the firm states.

129 SINGLE-PASS TAPS

Horspool & Romine Mfg. Co., Inc.—A 4-page catalog describes Acme taps with built-in lead screw action to provide full tapping with a single tool in one operation. Included is a specification-dimension table on standard taps in diameters from $^3/_8$ to $2^1/_2$ in. all standard thread pitches.

130 VALVES, CONTROLS

Hays Mfg. Co.—A packet of data sheets covers the firm's lines of solenoid valves, controls, strainers and automatic interlocks. Specifications, dimensions and flow charts are given.

131 ALLOWABLE WORKING PRESSURES

Ladish Co.—An 83-page reference work presents allowable working pressures conforming to Section 8 of the ASA Code for Pressure Piping B31.1 8-1955. Design pressures for various grades of pipe in sizes 6 through 42 in. are numerically tabulated, then plotted in chart form for each of the four basic types of construction covered in this standard.

132 PLASTIC RESINS

E. I. duPont de Nemours & Co.—Catalog A-2463 illustrates and describes characteristics, forming and working techniques and end-use applications of Teflon tetrafluoroethylene resin, Zytel nylon resin, Alathon polyethylene resin and Lucite acrylic resin. Detailed properties charts are listed.

133 MATERIALS HANDLING EQUIPMENT

Allen-Sherman-Hoff Co.—Data sheets on hydraulic and pneumatic materials handling systems and components describe and illustrate application, design and construction, operation, dimensions (for components) and typical arrangements. Engineering charts and technical data are also included.

YOUR *New Catalogs* GUIDE

134 VALVE OPERATORS

Tork-Master Div., Harvill Corp.—A brochure on features and application of automatic valve operators shows unique, patented design, to assure low-cost installation without altering new or existing valves, and without interrupting service.

135 VARIABLE-SPEED DRIVE

Reliance Electric & Engineering Co.—Bulletin D-2501 covers model VS-100 variable-speed drive, ½ to 4 hp. 100:1 speed range; 0.1 per cent speedload regulation.

136 RUST PREVENTION

Rust-Oleum Corp.—A general catalog contains 103 color chips showing colors available in primers, short oil type coatings, oil field finishes, restful color group finishes, machinery and implement colors, long oil type coatings, Galvinoleum coatings, heat resistant coatings, chemical resistant coatings, floor and deck coatings.

137 CONDENSATE RETURN UNITS

Ingersoll-Rand Co.—Complete condensate return units to suit any conditions are described in Form 7188. The package-type units have motor-pumps in a wide range of sizes. Either vertical or horizontal tank mounting is available.

138 HIGH TEMPERATURE WATER GENERATORS

International Boiler Wks. Co.—High temperature water generators are described in a 10-page bulletin, No. 700. Covered are specific features of forced recirculation generators; reasons are given on why high temperature water sytems are being selected in preference to high pressure steam systems.

139 BALL BEARING SWIVEL JOINTS

Chiksan Co.—A new 32-page catalog, G-4 covers the company's line of ball-bearing swivel joints, loading racks, manifolding lines, all-metal marine and barge hose, and flexible aircraft assemblies. Typical industrial applications are illustrated and dimensional and operating data is provided.

140 STATIC PRESSURE SEAL

Precision Rubber Products Corp.—An 8-page bulletin gives engineering data on Dyna-Seal, a one-piece seal with an inner sealing ring of resilient deformable synthetic rubber bonded to an outer confining steel ring. It is designed for sealing under bolt heads and such abutment flanges as the pipe union.

141 BI-COLOR GAGE

Diamond Power Specialty Corp.—Bulletin 1174 describes a new multi-port bi-color gage, developed to eliminate common gage troubles encountered in medium and high pressure ranges. The principle of dividing the vision slot into a series of individual, round ports is said to offer the solution to a number of problems that are intensified as pressure and temperature increase.

142 MULTI-V DRIVES

Worthington Corp.—A 100-page master engineering manual presents a scientific and simplified method for rating V-belts. Tables on drive selection contain nearly every possible stock sheave combination. Information on products and range of stock size sheaves with bore limitations is included.

143 AUTOMATIC BOILERS

Orr & Sembower, Inc.—Bulletin 1241 covers Powermaster packaged automatic boilers for light oil, heavy oil, gas or combination gas-oil firing in sizes to 500 hp. pressures to 250 psi. The units are completely factory assembled and have fully automatic operating and safety controls.

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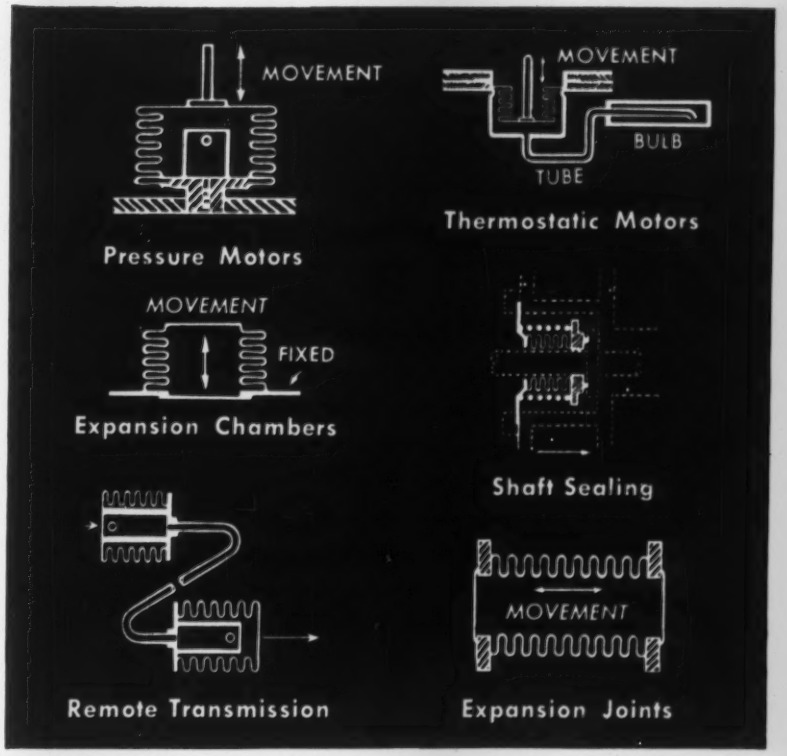

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The simple construction, straightforward operation, and light weight of Bridgeport seamless metal bellows make them the best answer for many temperature, pressure, and mechanical design problems. Hydraulically formed without soldered seams, they provide added strength and precision in shaft sealing, in obtaining controlled movement, in absorbing expansion or shock, in maintaining equal or differential pressures, and in transmitting motion remotely.

Bridgeport also offers two plus factors to make the most of any bellows application. Through integrated engineering of the bellows and all accessories, Bridgeport can supply complete bellows assemblies of many types, sizes, and metals. Ultra-modern production and quality control facilities assure increased uniformity and cost savings.

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Robertshaw-Fulton CONTROLS COMPANY

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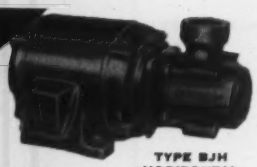

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General Purpose
CLOSE-COUPLED
CENTRIFUGAL PUMPS

These are compact, simple, lasting pumps with low NPSH characteristics to meet critical suction conditions — for wide range of duties including hot water and chemicals handling.

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*In special alloys to meet specific conditions

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MANY VALUE FEATURES

CONSULT WITH US

SEALS or GLANDS — Available in either as desired.

SPEEDS — 3,500, 1750 (60 cycle) and 2,880, 1,440 (50 cycle) speeds.

CURRENT — AC or DC — All voltages and phases.

MOTORS — 1/6 to 7-1/2 H.P. drip-proof, splash-proof, totally enclosed, explosion-proof and chemical. Quiet, efficient NEMA standard.

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WRITE FOR BULLETIN 119

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GENERAL MOTORS CORP.
Flint 2, Mich. Milwaukee 2, Wis.

YOUR *New Catalogs* GUIDE

144 VALVE SPECIFICATIONS

Cla-Val Co.—Catalog covers a standard line of ASA 125 and 250-lb class valves of the following types: vacuum relief, pressure relief, pressure reducing, pump control, rate of flow controller, check, remote control valves and controls, float solenoid and altitude. Catalog includes design and material specifications and list prices.

145 CENTRIFUGAL PUMPS

Dean Bros. Pumps Inc.—Circular No. 190 illustrates Type GS standard centrifugal pumps for general and chemical service. Design and construction data is given, along with a sectional view and parts list and dimension prints of the various units in the series.

146 CLOSED CELLULAR RUBBER

Rubatex Div., Great American Industries, Inc.—An 8-page catalog shows diversified applications, advantages, physical and thermal properties of Rubatex nitrogen-filled closed cellular rubber for sealing, gasketing, cushioning, vibration isolation and packaging applications.

147 LUBRICANT DATA

Fiske Bros. Refining Co., Lubriplate Div.—1957 edition of The Lubriplate Data Book to all who are interested in subject of proper lubrication of all types of machinery. This new Data Book is $8^1/_2 \times 11$ in. in size and contains 36 pages of valuable data pertaining to improvement of machine operation, reduction of power consumption and lowest possible maintenance costs through the use of specialized time tested lubricants.

148 LOCKING RING

Rosan Inc.—A catalog illustrates and describes a locking ring for inserts and studs. The principle of the unit's operation is described, and specifications of locks, inserts, studs and screws are included in the 42-page booklet.

149 SLITTING LINES

Yoder Co.—A 76-page booklet provides basic information on design selection and operations of slitters and slitting lines, including time studies and analysis of operating cycle, discussion of coil handling and scrap disposal methods. Specifications and capacity tables on the firm's uncoilers, slitters, recoilers, coil cars and scrap choppers are included.

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YOUR

New Catalogs

150 OIL HYDRAULIC POWER EQUIPMENT

Vickers Inc.—Catalogs 5001B and M5101A contain general design information and specifications of a line of hydraulic pumps, valves, controls and transmissions for hydraulic power systems for industrial machinery and mobile equipment.

151 SELF-ALIGNING COUPLINGS

Koppers Company, Inc., Metal Products Div.—A 6-page folder illustrates and describes principles and features of Fast's self-aligning couplings. A table of utility factors for various kinds of connected machines and tables of rating for standard forged-steel and heavy-duty couplings are included.

152 LIQUID LEVEL GAGES

Jerguson Gage & Valve Co.—An 8-page catalog, No. 291, covers remote reading liquid level gages, including a new Truscale with scale that flashes continuously in red when boiler water level gets too high or too low. The catalog is illustrated with photographs and engineering drawings. Gages in four pressure groups from under 900 psi to over 1500 psi are covered.

153 MINIATURE MECHANICAL CHAIN

Sierra Engineering Co.—Catalog describes miniature mechanical chain and sprockets, gives engineering data on chain which operates smoothly around a 7-tooth sprocket with a root diameter of .250 in. and has a pitch of .1475 in. The unit is for use where precise motion control is needed in miniature assemblies, especially where motion is to be transferred through several planes simultaneously.

154 UNDERGROUND CONDUIT SYSTEMS

Stillwater Clay Products Co.—A four-page brochure describes vitrified clay conduit systems. This illustrated brochure describes the revolutionary new and exclusive Cert-A-Bar tunnel and Lock-A-Bar round systems, and the many features of conduits, designed to assure permanent protection for piping. Information on conduit design, installation, engineering, insulation, waterproofing specifications and fittings also is included.

155 STEEL TUBING

Bundy Tubing Co.—A 12-page catalog contains technical information on physical properties, available sizes and method of manufacture of steel tubing. Also included are possible applications and methods of fabricating.

156 GAS, OIL BURNERS

Engineer Co.—Bulletin OB-53 illustrates different types and sizes of gas and oil burners and includes engineering data and specifications for pumping and heating sets for all types of liquid fuels.

157 BALL THRUST BEARINGS

Gwilliam Co.—Catalog No. 28 describes, illustrates and lists standard sizes of various types of ball thrust bearings, roller thrust bearings, and journal roller bearings.

158 BOILER FEED PUMPS

Pacific Pumps Inc.—Bulletin 122 illustrates and describes boiler feed pumps for high-pressure service. Included are 4-color cutaway photos showing features of the pumps, a performance chart and a discussion of pump design and manufacturing.

159 CUSTOM GEARS

Cincinnati Gear Co.—Illustrated folder describes and shows examples of types of gears produced to individual sepcifications only for all types of machinery and products. Gear types listed include spur, helical, rack, worm, herringbone, bevel, spiral bevel, internal, sprocket, zerol and coniflex.

160 LAPPING MACHINES

Crane Packing Co.—Literature describes Model 72 lapping machines. The spider bar and roller bar attachments have been improved and an ammeter has been added as standard equipment.

161 FLEXIBLE SHAFTING

Elliott Mfg. Co.—Circular 247 shows applications of flexible shafting in conveyor systems, printing machines, outboard motors, gas engines, mixers, grinders, farm and automotive equipment. A selection chart is also included.

TIMKEN Company ORDERS 2 MORE DIAMOND ITV UNITS

(WIRED TELEVISION)

AFTER 3 SUCCESSFUL INSTALLATIONS

Picture of furnace interior on Diamond ITV viewing screen is watched by remote dispatcher. A flip of a switch and he SEES conditions in another furnace on same screen.

Operator at another control pulpit SEES a visually inaccessible billet loading area for a pusher type furnace.

The Timken Roller Bearing Company made its first application of Diamond Industrial TV in August 1951 for remote observation of the interior of a tube-cooling furnace. Since that time two additional installations have been made to watch (1) the inside of another furnace and (2) the remote handling of billets by a crane. The success of these has resulted in a recent order for two more sets of Diamond ITV.

You, too, probably can use Diamond ITV to substantial advantage. Call your Graybar Distributor or use the coupon below.

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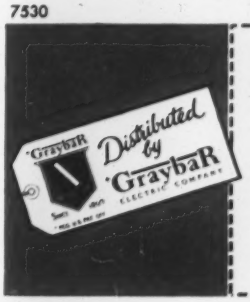

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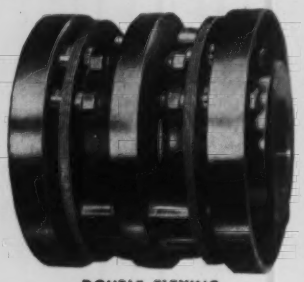
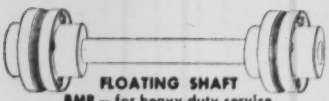


DOUBLE FLEXING
DBZ — for high speed, heavy duty drives



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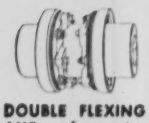
BMR — for heavy duty service with excessive misalignment



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AMR — for engine and medium speed drives

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SS — for engine-driven generator sets with out-board bearings

Thomas' 40 years of flexible coupling experience is at your disposal to help you meet ordinary applications or special variations for unusual cases.

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1 Freedom from Backlash Torsional Rigidity
2 Free End Float
3 Smooth Continuous Drive with Constant Rotational Velocity
4 Visual Inspection While in Operation
5 Original Balance for Life
6 No Lubrication
7 No Wearing Parts
8 No Maintenance

Write for Engineering Catalog 51-A

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA, U. S. A.

YOUR **New Catalogs** GUIDE — LATEST INDUSTRIAL LITERATURE

162 FILTRATION EQUIPMENT

Croll-Reynolds Engineering Co., Inc.—Bulletin describes the company's method of filtration. Also included are specification data on sizes and capacities and a listing of the company's filtration facilities such as laboratory, pilot plant demonstrators and special engineering services.

163 OIL AND GAS BURNERS

Ray Oil Burner Co.—A new illustrated 16-page catalog gives specifications and capacities of commercial and industrial gas, oil and combination gas-oil burners. It covers fully automatic, semi-automatic, and manually controlled horizontal rotary oil burners, gas burners, and combination gas-oil burners; commercial and domestic pressure-atomizing types for oil, gas, or combination gas-oil inshot gas burners; forced draft packaged burners. Tables and other technical data are included to aid in selection.

164 STAINLESS STEELS

G. O. Carlson, Inc.—A four-page folder shows applications of stainless steel in plates, plate products, heads, rings, circles, forgings, flanges, bars, sheets. Products, equipment and services of the firm are discussed.

165 FLOW REGULATOR

Waterman Engineering Co.—An illustrated bulletin covers an adjustable flow regulator that is adapted for panel mounting on systems requiring a variable adjustment of the flow rate over a wide operating range.

166 INSULATION, REFRACTORIES

Johns-Manville—A 52-page bulletin illustrates and describes eleven lines of products: insulations and refractory products; Transite® asbestos-cement pipe; packings and gaskets; electrical products; Celite® diatomite filter acids and mineral fillers; Celite® diatomite catalyst carriers and metal Raschig rings; synthetic silicates; friction materials; pipe protection minerals; floorings.

167 FORCED, INDUCED DRAFT FANS

Green Fuel Economizer Co., Fan Div.—The company offers three bulletins: (1) covering mechanical forced draft and induced draft fans; (2) diffuser fans; (3) the company's Economizers; (4) Fly ash collectors; (5) Industrial air cleaners.

168 O-RINGS

National Seal Div., Federal-Mogul-Bower Bearings, Inc.—This National O-Ring Catalog is designed for broadest usefulness in all types of O-ring applications. Includes practical working information about O-ring applications, sizes, groove dimensions, back-up rings, and dust seals, and lists all National O-Rings and local National Motor Bearing offices.

169 FIXED TYPE GAGES

Sheffield Corp.—Catalog LTG-54, 148 pages, is composed of six sections covering the company's standard fixed type gages. A complete engineering manual for gage designers and users is included in the catalog.

170 PIPE WRAP

Rhopac, Inc.—Literature describes a new pipe wrap which combines an under-wrap of quality glass fiber insulating material and an outer wrap of vapor sealing tape. The new wrap is said to prevent condensation and sweating of cold water pipes and provide a highly efficient insulation for hot water pipes.

171 PENCIL SELECTOR

Eagle Pencil Co.—A booklet explains the fundamentals of pencil quality and tells how to select the proper pencil for manifold forms, legal forms, duplicating machines, checking, marking, stenos use, charting graphs, blueprint marking, drafting, and general writing.

172 CLAD STEEL EQUIPMENT

Lukens Steel Co.—A 28-page booklet covers the development, manufacture and properties of clad steels, the types of cladding materials available, design considerations, fabrication techniques and clad steel equipment applications.

173 PLOTTER, RECORDER

Librascope, Inc.—An eight-page bulletin illustrates and describes XY plotters and recorders for application in research facilities, computer systems, controls and data handling systems.

174 SPEED REDUCERS

Westinghouse Electric Corp.—Engineering manual gives information necessary to specify the correct speed reducer for particular applications. Selection, horsepower ratings, torque, capacities, overhung load values, dimensions, constructions, installation and maintenance data on single, double or triple reduction speed reducers are included in this booklet, B-6727.

175 THERMOSTATIC BIMETAL

W. M. Chace Co.—A 44-page illustrated booklet describes and explains twenty-six uses of the company's thermostatic bimetal as regulating, controlling or actuating elements in temperature responsive devices. Included are ten pages of engineering data for element design and selection.

176 CENTRIFUGAL PUMPS

C. H. Wheeler Mfg. Co.—Double suction single-stage centrifugal pumps are described in an 8-page bulletin. The pumps are recommended for general service wherever liquids of low voscosity are to be moved.

177 SILICONE PRODUCTS

Garlock Packing Co.—An eight-page bulletin No. AD-147 covers silicone products for use in diaphragms, gasketing, sheet packing, oil seals, rings, insulation, tape, rod and valve stem packings, and for molded, extruded, die-cut and metal-bonded shapes for various uses. Silicone sponge applications are included.

178 ALUMINUM ALLOYS

Kaiser Aluminum—A 28-page booklet offers information on mill products and services. Data is given on aluminum alloys, forms, mechanical and physical properities, applications, fabricating and finishing techniques and availability. Products include sheet, plate, foil, circles, pig, alloy ingot, rod, bar, wire, electrical conductors, forgings, extrusions, extrusion billets, roofing, siding.

179 FORGED STEEL VALVES

Ohio Injector Co.—A bulletin illustrates and describes two new forged steel gate lines, 1100 series high flow and 1300 series high flow. An exploded view shows component parts. Trim and pressure-temperature charts are included.

180 VIBRATING CONVEYORS

Carrier Conveyor Corp.—"Natural-Frequency" vibrating conveyor Bulletin No. 112, 12 pages, describes new application of scientific natural-frequency vibrating principle as applied to Carrier

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vibrating conveyors with great reduction in power requirements, double capacity, and significant savings in maintenance and down-time costs. Illustrates applications for detergent powder, crushed stone, foundry sand, castings and shake-out, spiral elevating for air cooling and other drying, heating, separating and blending processes; other uses and engineering data.

181 STEAM TURBINES

Terry Steam Turbine Co.—Bulletins in looseleaf form which cover a complete description of Terry solid wheel turbines with cross section drawings of typical units for both moderate and high steam pressure conditions: a description of the Terry axial flow impulse, both single stage and multi-stage; Terry gears which are used for speed increasing and speed reducing.

182 SERVOMECHANISM GEAR BOX

Link Aviation, Inc.—An 8-page bulletin describes the Link Hi-Precision gear box, designed for use in quality computer, servomechanism and testing equipment. Adapters and couplings are also described. The gear box is available in ratios from 10:1 to 3125:1. Size is $3^1/_2 \times 3^1/_2 \times 2^7/_{32}$ in., for all ratios. Also, 2-page bulletin describing the Link Model 013 dual output gear box.

183 INFRARED PACKAGE

Beckman Instruments, Inc., Scientific Instruments Div.—A package of reprints contains scientific and engineering informaiton on infrared spectroscopy. Also included is a bulletin on a new infrared spectrophotometer.

184 TUBE EXPANDERS

Gustav Wiedeke Co.—Catalog 81 contains specifications on the firm's line of tube expanders and cutters. Included are tables of sizes, ordering information and a list of domestic and foreign distributor locations.

185 FLUID POWER EQUIPMENT

Oilgear Co.—A 12-page Bulletin 10051-E gives condensed information and specifications on equipment for fluid power transmission applications. It covers constant and variable delivery, duplex and automatic feed pumps, constant and variable displacement motors, hydraulic motors with reducers, variable speed transmissions, standard and heavy-duty cylinders, pilot, directional, relief, foot, surge, combination and differential valves.

186 SUPER REFRACTORIES

Carborundum Co., Refractories Div.—"Properties of Super Refractories," twenty-four pages, covers latest data on super refractories including newly developed compositions for specialized applications. Re-frax silicon-nitride bonded silicon carbide refractories which can be produced in intricately designed shapes to close dimensional tolerances is described. Chemical analysis and physical property charts are provided on all materials.

187 GASKETS METAL RASCHIG RINGS

Metallo Gasket Co.—Bulletin No. 53 describes metal and metal combined with soft packing for use on high and low pressure service, metal tower packing made as Raschig and Lessig rings. Also included are washers, shims, and metal asbestos valve disks.

188 PIPING INSULATION MANUAL

American Gilsonite Co.—A 20-page Booklet covers the methods of application of Gilsulate, a new insulation for hot underground pipes. It describes the three grades, how to determine ditch size for various pipes and types of soil, and gives sample problems.

189 RADIAL FANS

Buffalo Forge Co.—Bulletin FD205 illustrates and describes type CR radial blade type fans for industrial and power plant service. Performance characteristics, selection and dimension data are given.

190 AUTOMATIC VALVES

A. W. Cash Co.—A four-page bulletin, No. S-730, illustrates and describes 27 items of standard automatic valves and controls. These items are a portion of the complete line designed to meet every type of control problem.

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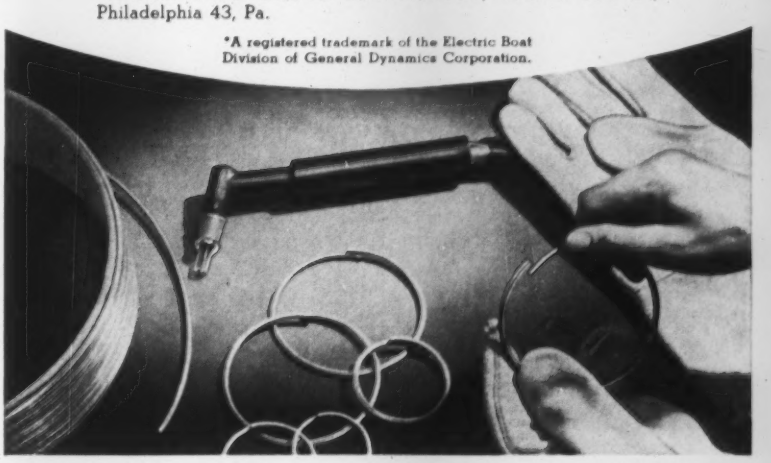
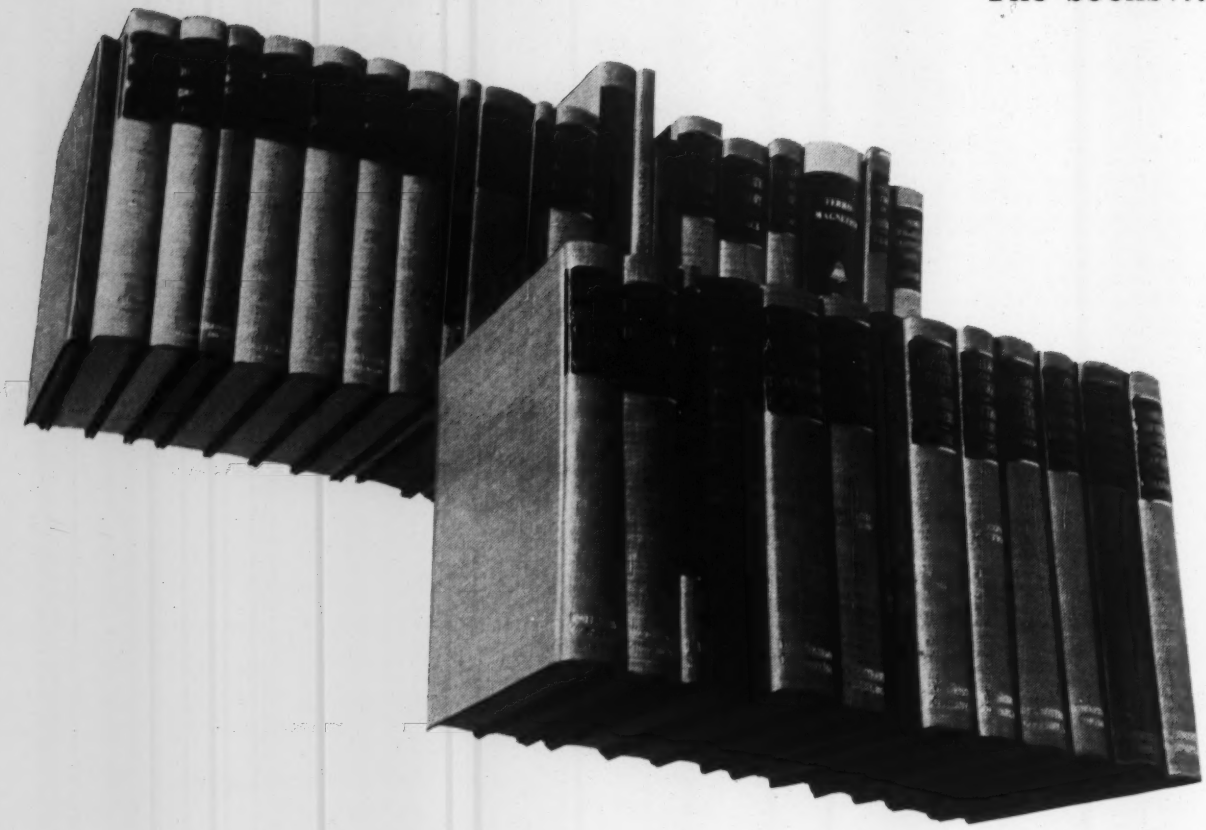


The books...



How the scientific world shares in fruits of the telephone art

In their work to improve telephony the scientists and engineers of Bell Telephone Laboratories make important findings in many sciences. They thoroughly report these findings in professional journals and magazines. But sometimes, as knowledge accumulates in a vital field, a "treatment in depth" is prepared in book form.

Bell Laboratories authors have written 36 books to date and others are in preparation. Many have become classics in the Laboratories' primary field of communications. Many have become standard works of wide application because they provide a fundamental guide for technologies in other fields. For example, the design of automatic switching systems is of primary importance in computers; statistical quality control provides the indispensable basis for economical manufacture. Through their books these scientists and engineers and the Laboratories attempt to repay benefits they receive from the published works of others.

The pictures on the opposite page show some Bell Laboratories authors of technical books. A complete listing of titles may be obtained by sending in this coupon.

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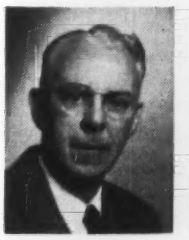

Harold S. Black, B.S. in E.E., Worcester Polytechnic Inst., author of "Modulation Theory."

John R. Pierce, Ph.D., California Inst. of Tech., author of "Traveling-Wave Tubes."

Richard M. Bozorth, Ph.D., California Inst. of Tech., author of "Ferromagnetism."

W. Thornton Read, M.S., Brown University, author of "Dislocations in Crystals."

Hendrik W. Bode, Ph.D., Columbia University, author of "Network Analysis and Feedback Amplifier Design."

Walter A. Shewhart, Ph.D., University of California, author of "Economic Control of Quality of Manufactured Product."

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LATEST INDUSTRIAL LITERATURE

191 MINIATURE BALL BEARINGS

New Hampshire Ball Bearings, Inc.—A catalog features an article on factors to consider in selecting miniature bearings. Tables are laid out by bore size. Ordering instructions and explanation of symbols are included along with engineering bulletins giving technical details. Short form catalog gives quick identification of standard bearings.

192 CENTRIFUGAL PUMPS

Goulds Pumps, Inc.—Two bulletins cover pumping applications in industry. Bulletin 721.6 shows 19 sizes single stage double suction centrifugal pumps for capacities up to 6400 gpm, heads up to 400 ft. Bulletin 722.6 shows 5 sizes two-stage centrifugal pumps, capacities up to 1200 gpm, heads up to 1000 ft. Maximum of standardization and interchangeability of parts are described.

193 SPEED REDUCERS

Winsmith, Inc.—Catalog 155, 112 pages, covers more than 150 models, including the recently introduced "C" series. It contains engineering selection data and is sectionalized for quick and easy reference to all information. A special general engineering section is included to aid in solving application problems.

194 PIPING PRODUCTS

Midwest Piping Co.—A 192-page bound catalog illustrates and describes welding fittings, forged steel flanges, prefabricated piping, pipe coils. Comprehensive design and application data is included.

195 CONDENSER, HEAT EXCHANGER

Bridgeport Brass Co.—A 162-page illustrated handbook covers copper alloy tubes for condensers, heat exchangers, evaporators and general piping used in power plants, ships, oil refineries, chemical and petrochemical plants and process industries.

196 TEMPERATURE INDICATING COLORS

Curtiss-Wright Corp., Research Div.—A 28-page booklet outlines details on Thermocolor pigments that indicate temperature by color change. The temperature range of 104 F to 2962 F is indicated by 36 different pigments. Twenty pigments change color once; 9, twice at successive temperatures; 5, three times; 2, four times.

197 BOILERS

Brown Fintube Co.—Bulletin No. 554 illustrates and describes the construction, operation, controls of boilers in capacities of from 30 to 350 hp. Dimensions and specifications are tabled.

198 STEAM TRAPS

Armstrong Machine Wks.—A 44-page manual on condensate drainage contains data on semi-steel and forged traps, discusses the fundamentals of good trapping, and deals with trap selection problems, installation, repair and trouble shooting.

199 THREAD INSERTS

Heli-Coil Corp.—Catalog on standard line of screw thread inserts designed for protection and repair of tapped threads in all materials is contained in Bulletin 652-A. Covered are design information, drilling and tapping recommendations, and specifications for various classes of fit. Also available is Bulletin 738 which provides similar details on new screw-lock insert which eliminates the need for lock washers, lock nuts, lock wiring.

200 BALL BEARINGS

Federal Ball Bearings Co.—Catalog D-1 contains 24 pages of dimensional tables for selection of ball bearings according to size, and assists in the identification of ball bearings for which a repalcement is required. Both metric and inch measurements are shown. Catalog also includes interchange and conversion tables.

201 CHROMIUM

Van der Horst Corp.—A 12-page illustrated brochure describes Porus-Krome, a porous, hard, wear and corrosion resistant chromium designed to increase life of internal combustion engine cylinders and compressor cylinders. Process is used for new equipment and reclamation of power cylinders in the marine, aviation, railroad, and oil and gas industry.

202 BOILER SERVICE VALVES

Everlasting Valve Co.—Bulletin describes the Everlasting Quick-Opening and Slow-Opening Straightway Valves, Angle Valves, Y Valves, and Duplex Blow-Off Units, with specifications, materials of construction, and dimensions of each type. Illustrations include details of design, sectional and exploded views, and explanations of operation of the valves. A section of the bulletin also describes Everlasting Valves for fire protection.

203 PROCESS CONTROLS

Powers Regulator Co.—A 100-page general industrial catalog describes devices for industrial processes, domestic hot water control systems, and space temperature and humidity control. Pneumatic and self-contained temperature controllers; indicating, recording, and/or controlling temperature, pressure, and humidity instruments; diaphragm and bellows valves; push stem air motors; psychrometer and aspirator assemblies; steam traps, and air switches and relays are covered.

204 ECONOMY BOILER

Francis Steam Generator Co.—A 4-page bulletin illustrates and describes features of an automatic water-tube boiler with fast recovery for such applications as dry cleaners, laundries, bakeries, canneries, milk product plants, dairies, wineries, bottling plants, food processors, tire retreaders, feed mills, institutions. Diagrams show a dual circulation system and a preheated feed-water system.

1956 MANUAL OF CONSULTING PRACTICE FOR MECHANICAL ENGINEERS

A Guide for Consulting Engineers and Their Clients

It sets forth the proper approach in obtaining professional engineering services, in establishing the fundamental structure in engineering agreements, and in setting up conditions applicable to the conduct of engineering assignments under various types of agreements.

CONTENTS Engineer-Client Relationship. Selection of the Engineer on Merit Basis. Engineering Services (Advisory, Appraisals, Management, Production, Inspection or Testing, Design Projects). Contracts for Services. Basis for Making Charges (Annual Retainer Fees, Per Diem, Retainer Plus Per Diem, Lump-Sum, Cost Plus a Fee, Percentage of Cost of Work, Repetitive Work, Mechanical Equipment of Buildings). Principles of Settlement for Delayed or Terminated Projects. Reuse of Plans. Patents. Confidential Data. Canons of Ethics.

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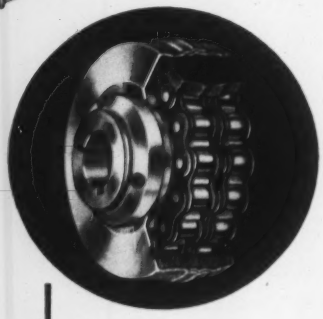

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205 HYDRAULIC MACHINERY

Watson-Stillman Press Div., Farrel-Birmingham Co.—A 24-page bulletin gives information on injection, compression, and transfer molding machines for the plastics industry; extrusion presses for ferrous and nonferrous metals; metalworking equipment; railroad shop equipment; ordnance equipment; standard and special machinery for general industrial applications.

206 ALUMINUM PIPE, FITTINGS

Aluminum Co. of America.—A 16-page booklet covers process piping, pipelines, portable piping, structural piping applications, fittings and flanges, installation, dimensions and weights of aluminum pipe and fittings.

207 HIGH PRESSURE COMPRESSORS

Norwalk Co., Inc.—Catalog No. 44 illustrates and describes multi-stage high pressure air and gas compressors. Included are single and two stage compressors, three stage compressors, semi-portable compressors, four stage, five stage and six stage compressors, boosters and special compressors, vertical compressors, conversion tables and installations.

208 OPTICAL TOOLING

Charles Bruning Co.—A 20-page illustrated booklet, explaining the theory, principles, and practice of the new technique of optical tooling. The booklet shows how optical tooling provides tolerances of .003 in. in 100 ft. It is claimed to offer easier construction, assembly, inspection, and insurpassed dimensional control in erecting jigs, fixtures, and assembly structures.

209 GEARS, GEAR ASSEMBLIES

Advance Gear & Machine Corp.—Catalog illustrates and explains various types of gear cutting done as well as a representative group of special gears and gear assemblies produced. All types of custom gear cutting and gear assemblies to customers' specifications as well as many assemblies of their own design are offered by the company.

210 SPECIAL GLASSES

Corning Glass Wks.—Properties of such selected commercial glasses as Pyrex, Corning and Vycor are described in bulletin B-83. Data and tables on mechanical properties, thermal stresses, heat transmission, electrical properties, corrosion resistance, and viscosity are included.

211 OIL HEATING BOILER

National-U. S. Radiator Corp., Heating & Air Conditioning Div.—The Premier oil heating boiler is featured in a 4-page catalog, Form 831. The unit is described as a wet base cast iron boiler of the 25B series, made to meet the heating and domestic hot water requirements of from large residential to small commercial installations.

212 REMOTE VALVE CONTROL

Stow Mfg. Co.—A 16-page design manual covers the use of flexible shafting for remote valve control. A chart is given for the selection of the correct size shaft for any valve. Different types of end connections are shown.

213 STEEL TUBULAR HEATERS

Mammoth Furnace Co.—Literature describes direct-fired space heaters in capacities from 300,000 to 2,000,000 Btu for commercial and industrial space heating requirements, and oil, gas, stoker and hand-fired vertical steel tubular heaters in capacities from 175,000 to 2,379,000 Btu for churches, schools, factories, auditoriums, commercial buildings.

214 INDUSTRIAL WHEEL

Roll-Rite Corp.—Bulletin 1302 illustrates and describes a new wheel which utilizes a molded rubber tread bonded vertically between two steel disks. By compressing the disks, a displaced and inflated tread is provided to support heavy loads in industrial materials handling applications.

215 SELF-LOCKING SCREWS

Standard Pressed Steel Co.—A 16-page booklet on self-locking socket head cap and set screws describes self-locking insert, gives specifications and performance data on material. Sizes, dimensions and packaging information is included.

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216 MOTOR CONTROLS

Clark Controller Co.—An 84-page catalog covers, manual and magnetic across-the-line starters, motor control centers, reduced voltage and synchronous motor starters, high voltage across-the-line starters, a-c and d-c contacters, a-c and d-c relays. Specifications and dimensions of all units are diagrammed and tabled.

217 UNIT STEAM GENERATOR

Preferred Utilities Mfg. Corp.—A 26-page booklet illustrates and describes the design and construction features of unit steam generators. Application photos, checklists and dimension tables are included.

218 SPEED REDUCERS

Stephens-Adamson Mfg. Co.—Catalog 643 covers single and double reduction type speed reducers. Specifications and dimensions are tabled, and installation information is given. A section of the 12-page booklet deals with the firm's materials handling equipment.

219 COUNTING DEVICES

Veeder-Root, Inc.—Modern mechanical and electrical counters for all industrial and special counting requirements are briefly described in a four-page condensed general catalog. Also contains information on applications and how-to-order.

220 ALLOY TUBING AND PIPE

Babcock & Wilcox Co., Tubular Products Div.—A 46-page pocket-sized manual covers the methods of working seamless tubes and pipe made of the firm's intermediate Croloys. Sections in the booklet include nominal composition, general characteristics, annealing practice, methods of working, welding and condensed technical data.

221 FLEXIBLE COUPLINGS

Poole Foundry & Machine Co.—A 136-page manual illustrates, describes and gives engineering specification and lubrication data on flexible couplings.

222 OIL FILTERS, STRAINERS, OILING DEVICES

Wm. W. Nugent & Co., Inc.—Seven bulletins: No. 6 illustrates and describes Nugent pressure strainers; No. 7 gravity filters; No. 7A pressure filters; No. 8 tanks, pumps, shaft oilers; No. 14 oiling and filtering systems for turbines, paper mills, steel mills, pumps, compressors; No. 15 oiling devices; No. 16 sight feed valves, multiple oilers, flow indicators, sight overflows, and compression union fittings.

223 ALUMINUM

Revere Copper & Brass, Inc.—"Revere Aluminum Products" 36 pages, discusses the advantages of aluminum alloys, the variety of extruded products available, the uses to which seamless drawn tube and pipe can be put, and the uses of sheet, bus bar, and die-pressed forgings. It contains many tables giving both mechanical and physical properties.

224 PLANT SKYLIGHTING

Resolite Corp.—A 4-page folder illustrates use of Fiberglas panels for industrial plant skylighting. It includes fire retardant Fire-Snuf, now Factory Mutual approved and labeled by Underwriters' Laboratories. Data on light transmission, weights, loading characteristics and a table of sheet sizes and corrugations are included.

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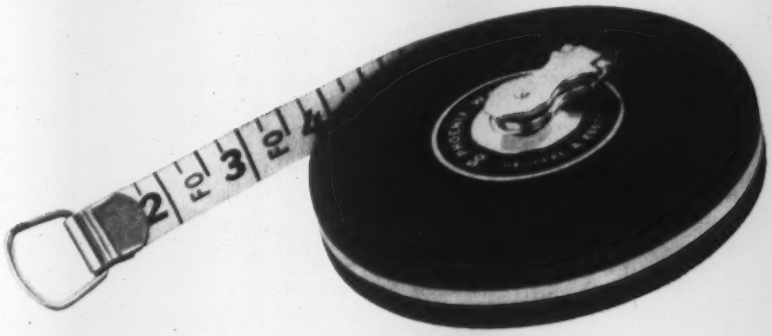

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225 COAGULATOR

Hungerford & Terry, Inc.—A 16-page bulletin illustrates and describes a new coagulator which is a high speed upflow solids contact type coagulation and settling unit for use in water clarification, water softening and waste water treatment.

226 BOILER CONTROLS

McDonnell & Miller, Inc.—A Catalog describes boiler water level controls and safety devices. Product illustrations, brief descriptions, capacity curves, dimension details and service recommendations are included.

227 POWER TRANSMISSION PRODUCTS

Boston Gear Works.—A 576-page, pocket-sized catalog contains information on 7,124 standardized power transmission products. More than 50 pages of engineering data are included.

228 HIGH-STRENGTH STEELS

United States Steel Corp.—A 174-page manual discusses the essential principles of structural design and contains numerous formulas, charts and tables to assist in designing, for high-strength steels. The hard cover, ring-bound book covers engineering considerations and fundamental characteristics of high-strength steels, design considerations, working unit stresses, tension, compression, shear, stresses in beams, deformation and deflection, formed sections and designing against corrosion.

229 WATER COLUMNS, GAGES

Ernst Water Column & Gage Co.—Bulletin 8-1-56 illustrates and gives specifications of bronze gages, flow indicators, water columns, steel gages and valves, gage glasses and gaskets.

230 SILENT CHAIN

Link-Belt Co.—A 16-page bulletin, No. 2510, describes a tiny, precision-built chain with positive contact of gears designed for installation in compact spaces on such machines as motion picture projectors, recording devices, portable sanders and planers. The chain is available in side-flange, middle-guide and duplex types in a variety of widths.

231 REFRACTORIES

Norton Co.—A 32-page instructional manual illustrates and describes the application and suggested uses of Crystolon silicon carbide refractories in boilers. Included are curves of thermal conductivity and air flow through air cooled walls.

232 VINYL VALVES

Lunkenheimer Co.—Circular 601 describes new all-molded polyvinyl chloride valves, which are light-weight and corrosion resistant. Molded in rigid form, the valve is said to be suitable for pressures up to 125 psi and temperatures to 150 F. Large, cutaway illustration shows design detail. The circular lists industrial fluids these valves handle, features of valves, and dimensions.

233 STEAM DISTRIBUTING TUBE

John J. Nesbitt, Inc.—Catalog 305-1 illustrates and describes new Series T steam distribution tube type heating surface employing the principle of two steam passes in each distributing tube to eliminate stratification under modulated steam control. Each tube serves two adjacent condensing tubes.

234 DIAPHRAGM VALVES

Hills-McCanna Co.—A 12-page catalog, No. 100, describes diaphragm valves in terms of their advantages, applications and specifications. The three basic types of valve operations are shown and dimensional specifications are given. Information is also included on plastic bodies.

235 SOCKET SCREWS

Allen Mfg. Co.—General catalog, G-56-R, 40 pages, describes the line of hex socket screws and precision fasteners, including flat and button head cap screws, shoulder screws, pipe plugs, dowel pins, Allenuts, and hex keys. Included are engineering data and standards pertaining to socket screws.

236 OIL, GAS BURNERS

Petro—Catalog 3356 gives 20 pages of information on the selection of equipment, engineering

FOUR New Catalogs GUIDE

and manufacturing factors, design and construction features, types of controls, and types and ratings of Petro packaged units for oil, gas and combination oil-gas burners.

237 PUNCHES AND DIES

T. H. Lewthwaite Machine Co.—New, revised catalog sheets list the range of metal-working punches and dies carried in stock for immediate shipment. Styles to fit most makes of hand-, foot-, and power-operated punch presses are standard. Hand-operated punches, cutters, and benders are also illustrated and described.

238 FLEXIBLE, SWIVEL, SWING, AND REVOLVING JOINTS

Barco Mfg. Co.—A group of catalogs cover flexible, swivel, swing, and revolving joints for piping and lines conveying steam, oil, air, gasoline, water, chemicals, including corrosive acids and alkalies, and other fluids or gases. Types cover pressures up to 750 psi, steam, and 7500 psi hydraulic. Complete range of sizes. Catalogs No. 215 "Flexible Ball Joints"; No. 265 "Rotary Swivel Joints"; No. 400 "Barco Swing Joints"; No. 310 "Revolving Joints" and No. 269 "High Pressure, Hydraulic Swivel Joints."

239 METERED LUBRICATION

Bijur Lubricating Corp.—A four-page bulletin "The ABC of Modern Lubrication" describes automatic lubricating system components. All systems consist of a lubricator, distribution system and a Meter Unit for each bearing served. The bulletin describes lubricators for rotary, oscillating, hydraulic, solenoid, or hand operation.

240 POLYVINYL PRODUCTS

B. F. Goodrich Chemical Co.—A booklet gives properties and illustrates applications of Geon vinyl resins for industrial and consumer uses in extrusions, film and sheeting, molded products, expanded vinyls, coatings and rigid materials.

241 WELDING PIPE FITTING

Bonney Forge & Tool Wks.—A data sheet illustrates and describes a unique branch welding pipe fitting for constructing angular branch connections with a full penetration weld. The units, called Elbolets, are used for making 45-deg. connections for directional flow and instrument connections, and for connections into elbows for instruments, drips, hanger and support connections.

242 ROLLER CHAIN

Acme Chain Corp.—An illustrated 76-page catalog covers precision roller chain and sprockets, flexible couplings, special conveyor attachments. Horsepower charts and standards to assist in design and application problems are presented.

243 HEATING EQUIPMENT

Iron Fireman Mfg. Co.—A 60-page booklet covers engineering data on oil, gas and coal fired heating and power equipment. It is designed, not as a service manual, but to provide architects and engineers with information for better understanding the problems of fuel handling.

244 PHOTOELASTIC POLARISCOPE

Polarizing Instrument Co.—A catalog describes four new polariscopes and two straining frames for using polaroid light control in industry.

245 CENTRIFUGAL PUMPS

American-Marsh Pumps, Inc.—6-page Bulletin 350 describes horizontal split case, single stage, double suction centrifugal pumps. Types HLM and HIM for wide range of capacity and head conditions. Large sectional view explains 18 important features. Specifications, performance data and dimension tables are included.

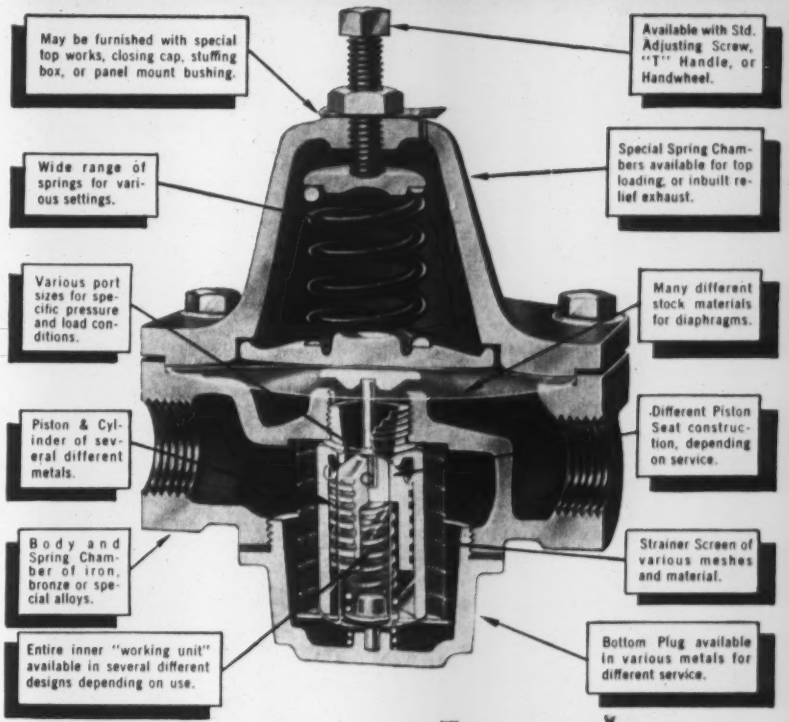
246 BALL BEARINGS

T. B. Wood's Sons Co.—Life-Lube bulletin No. 699 illustrates with dimensional information pillow blocks, flange units, take-up units. These standard 200 series bearings with wide inner ring, deep ball race groove are lubricated for life at the factor. They are completely self-aligning. Sizes range from $\frac{1}{2}$ to $2\frac{15}{16}$ in.

247 LIQUID METERS

Rockwell Mfg. Co.—Bulletin OG-411 describes large capacity Rotocycle meter line with new crank control design. Pictures and exploded view illustrate new simplified rotor measuring element now used in the 400, 600, and 1000 gpm meters.

how Cash-Acme provides the Correct Answer to 1,017 reducing valve cost problems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Piston & Cylinder of several different metals.
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Entire inner "working unit" available in several different designs depending on use.
Bottom Plug available in various metals for different service.

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Do as other cost conscious engineers and purchasing men are doing and switch to CASH-ACME.

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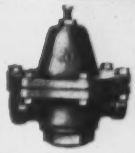

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Anthony J. Lucas

METHODS MANAGER, THE CINCINNATI GEAR CO.

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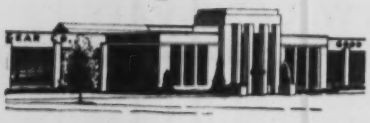

YOUR *New Catalogs* GUIDE

248 COMBUSTION EQUIPMENT

Hauck Mfg. Co.—The Catalog 52 gives a condensed and pictorial review of oil and gas combustion equipment for production, construction, and maintenance applications in industry. The catalog has 12 pages and 80 illustrations.

249 STEEL WIRE

American Chain & Cable Co., Page Steel & Wire Div.—A 16-page, DH-1226, catalog on Page shaped wire includes specification tables, range of sizes, physical properties of steel wire, table of standard wire gages, hardness conversion tables, with illustrations showing how to calculate areas of typical common shapes of wires. Size range includes cross-sectional area up to and including No. 3 BWG; flats and rectangles in widths up to ⅜ in., the ratio of width of thickness not exceeding 6 to 1.

250 HYDRAULIC FLUIDS

E. F. Houghton & Co.—Folders describe a new series of fire resistant hydraulic fluids supplementing the aqueous base fluids marketed by the firm. These are phosphate ester type fluids that have been fortified by the addition of materials to increase oiliness and rust prevention.

251 PRESSURE TRANSDUCERS

Pace Engineering Co.—A catalog describes four magnetic reluctance transducer models for gage and differential pressure measurement. Specifications of accuracy, sensitivity, dynamic response, and environment are given along with a discussion of operating principles. Auxiliary equipment for recording and control applications is also described.

252 METAL BONDING

Van der Horst Corp.—Bulletin describes application of Vanderloy, a patented process that bonds an electrolytic iron atomically with ferrous metals as well as aluminum, copper, nickel and their alloys. Main uses are to reclaim worn machine parts or mismachined parts, protect soft or perishable metals and electroform casting and stamping dies.

253 OPTICAL TOOLING

Charles Bruning Co., Inc.—A bulletin illustrates the firm's optical tooling instruments and shows their application in industry. Included are alignment scopes, transits, tooling bars and stands, and accessory equipment.

254 METAL STAMPINGS

Bossert Div., Rockwell Spring & Axle Co.—New eight-page folder illustrates facilities for stamping, machining, welding, grinding, plating and annealing either small or large parts or assemblies in any metal or alloy. Folder also describes engineering and re-design service for assistance in product development.

255 PROPORTIONING PUMP

Proportioneers, Inc., Div. B-I-F Industries, Inc.—Bulletin 1140 illustrates and describes Model 1140 chemical proportioning pump. The unit handles feed rates from 0.8 gph to 900 gph at discharge pressures up to 1340 psig.

256 SPRAY GUN

Metallizing Engineering Co.—Bulletin 125A illustrates and describes the firm's Type P Thermospray gun for use with alumina, zirconia, hard facing metals, stainless steels, bronze and other metals without compressed air.

257 OSCILLOSCOPE CAMERA

Brea Instruments—Data sheet describes high speed oscilloscope camera model OC-1 designed to photograph the signal on a cathode ray oscilloscope screen on a film strip moving uniformly in a direction across that of the signal. Specifications of film, film speed, optics, speed control and accessory reflex camera mount are given, along with a discussion of operating principles.

258 TUBULAR PRODUCTS

Jones & Laughlin Steel Corp.—A handbook contains information on the types of tubular products known as standard pipe and line pipe, which have their applications in domestic, industrial, power, and other similar installations. Standard mill practices, measurement of pipe, and other useful data and formulas are included.

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Oil Burners

OF THE STEAM AND MECHANICAL TYPES NOW COMBINED INTO

Dual Stage BURNERS

Now, at last, the inherent advantages of *both* systems of fuel oil atomization are *profitably* yours . . . within the one, new NATIONAL AIROIL Dual Stage Burner.

45 years of combustion equipment design and manufacture are in back of the Dual Stage Oil Burner . . . and, it has been thoroughly tested and proved in the field for firing: Petroleum Processing Heaters; Rotary Kilns; H.R.T., Scotch Marine and Water Tube Boilers; etc.

Available in three sizes, the NATIONAL AIROIL Dual Stage Burner fires all grades of fuel oil from No. 2 to No. 6, with a ready capacity of 80 to 300 g.p.h. Further, for a perfect flame pattern, we would recommend using with the Dual Stage Burner either the NATIONAL AIROIL Universal Register for forced draft or, the NATIONAL AIROIL Tandem Unit for natural or induced draft furnaces.

Get detailed descriptions, illustration, and specifications in NATIONAL AIROIL Bulletin 25.

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MECHANICAL PRESSURE ATOMIZING OIL BURNERS
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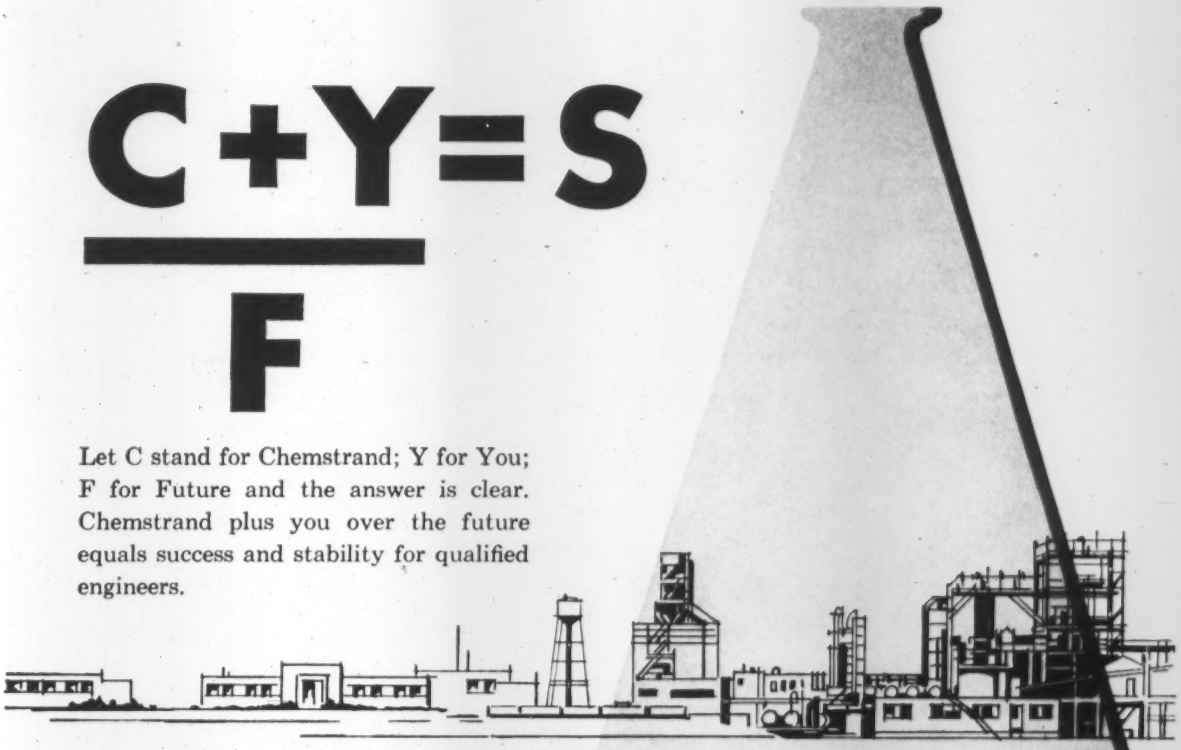

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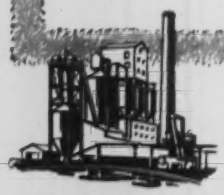
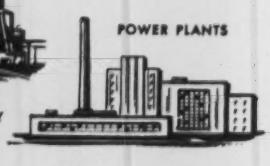


CHEMICAL PROCESS AND STEEL INDUSTRY



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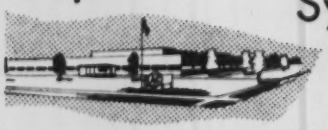

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YOUR *New Catalogs* GUIDE

259 SEALED BEARINGS

Stephens-Adamson Mfg. Co., Sealmaster Bearings Div.—Bulletin 455 illustrates and describes the firm's Sealmaster bearings. Standard and special units are available. Cutaway photos show such features as zone hardening, locking pin and perimeter dimple, labyrinth seal, ball retainer.

260 CONTROL VALVE

American Water Softener Co.—A four-page booklet, No. 600, illustrates and describes Cycloflow valve which can be applied to ion exchange processes. The valve is said to provide leakproof control of hydraulic flow, and is constructed of inert plastic materials for corrosive applications.

261 AUTOMATIC CONTROLS

Hagan Chemicals & Controls, Inc.—Bulletin GSP-901 illustrates and describes the firm's products and services. Included are brief descriptions of control systems and components for combustion control, metallurgical furnace control and aerodynamic testing control; the plant-wide water services of Hall Laboratories; the many chemical products of Calgon Co.

262 TRASH RACK RAKES

S. Morgan Smith Co.—Bulletin No. 158 illustrates and specifies Leonard mechanical trash rack rakes used to clean inclined or vertical stationary intake trash racks for hydro-electric stations, steam power plants, pumping stations. Standard arrangement drawings give dimensions of nine basic types and field photographs show typical installations. Supplementary folder describes two new self dumping rake designs.

263 SWIVEL JOINTS

Continental-Emsco Co.—Swivel joint catalog covers joints for use throughout the petroleum, chemical and general industry. Swivelettes are designed to provide flexibility on gasoline pump hoses, machine tool coolant lines, paint sprayers, liquid and air handling equipment at a very low cost allowing replacement rather than repair.

264 HAND FORGINGS

Aluminum Co. of America—A booklet answers questions on high-strength, low-weight advantages of aluminum for parts of limited production. The booklet presents detailed discussions of factors that influence the production of a quality hand forging.

265 WATER TANKS

Chicago Bridge & Iron Co.—A 16-page brochure describes two types of elevated water storage tanks. The Watersphere unit is offered in standard sizes from 25,000 to 250,000 gal. The Waterspheroid is offered in sizes from 250,000 to 500,000 gal.

266 TESTING DEVICES

Baldwin-Lima-Hamilton Corp., Electronics & Instrumentation Div.—Bulletin 4300 lists SR-4 devices and equipment for load, torque and fluid pressure measurement and control. Numerous application photos in all fields are included in this 20-page bulletin.

267 REMOTE DIGITAL WEIGHTS

Toledo Scale Co.—Brochure shows how digital scanners produce signals for transmission from remote locations to a variety of office machines for recording. It also describes the advantages offered by remote digital weights with suggestions on how they may be used in modern weighing systems.

268 WATER REDUCING VALVE

Leslie Co.—Bulletin 553 describes new "Hi-Flo" water pressure reducing valve, inlet pressure range, 10–250 psi, 180 F, reduced pressure ranges 5–30 and 25–80 psi, with 5 psi minimum pressure drop, sizes 1/2 to 2 in. in compound treated cast iron. Comparative capacity-regulation test results and sizing data is included.

269 MECHANICAL TUBING

Babcock & Wilcox Co., Tubular Products Div.—Bulletin TB-340 is a guide to the choice of seamless mechanical tubing. This eight-page bulletin describes the various methods of producing seamless mechanical tubing, the several types of surface finishes and machining qualities.

YOUR *New Catalogs* GUIDE

270 CLAMPS, WASHERS

Eaton Mfg. Co.—A 28-page bulletin illustrates and gives specifications of terminal clamps, keps, reliance rings, spring lock washers, hose fasteners, and other types of fasteners.

271 MOLY IRON CASTINGS

Climax Molybdenum Co.—Bulletin No. 1 explains that molybdenum is selected as an alloying element on the basis of performance and cost in typical iron castings. Bulletin No. 2 relates how the adaptability of molybdenum to foundry operations can benefit the user and the foundry.

272 STARTERS, RELAYS

General Electric Co.—A 32-page illustrated publication, GEA-6372, describes manual, magnetic, and reduced-voltage starters; push buttons; relays; limit switches; solenoids; pressure and vacuum, float, and plugging and anti-plugging switches.

273 DUST, FUME COLLECTORS

Northern Blower Co.—Bulletin 164 describes automatic bag type arresters, diagrams standard dimension factors and supplies table of dimensions and capacities. Separate additional bulletins contain similar data for standard bag type (not automatic), hydraulic type, centrifugal type, and portable dust collectors.

274 FLUID COUPLINGS

Twin Disc Clutch Co.—Bulletin No. 144-D gives installation and performance data on fluid couplings. Complete with diagrams and drawings, the bulletin shows the use of the firm's couplings on any type of industrial equipment powered by electric motors or internal combustion engines from ¾ to 850 hp.

275 MOTOR SELECTION

General Electric Co., Motor Dept.—Bulletin GEA-6200, covering a-c motors of 1 to 30 hp, is designed to answer questions concerning the purchase of motors for machines. Service, stocking, motor enclosures, drive requirements, mounting requirements, application information are illustrated and described.

276 PLATE FABRICATION

Downingtown Iron Wks., Inc., Div., Pressed Steel Tank Co.—Bulletin DIW-1 entitled "This is Downingtown Iron Works" describes engineering experience and plate fabrication work. Some of the metals, alloys and other materials fabricated are listed.

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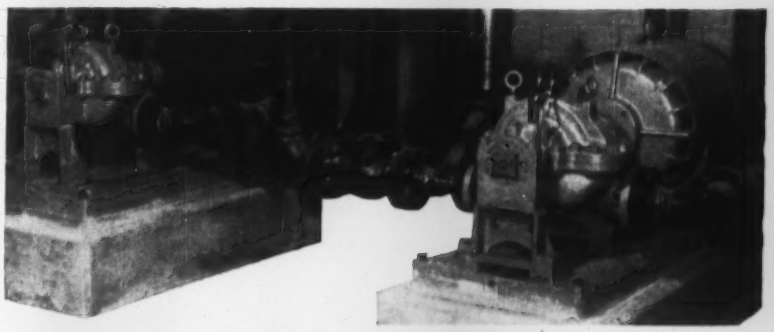
They needed pumping capacity



They needed pumping pressure

You can have capacity . . . or pressure . . . or both

You can meet an exceptionally wide range of pumping needs with just two types of Goulds pumps.

For volume pumping—33 sizes of the Fig. 3405 single-stage, double-suction pump provide capacities up to 6400 GPM, heads up to 425 ft.

For great pressure—5 sizes of the Fig. 3305 two-stage pump provide heads up to 1000 ft., capacities to 1200 GPM.

All these *extra* features are *standard* on both groups:

1. Bearing housings sealed against dust and moisture.
2. Renewable stuffing box bushings.
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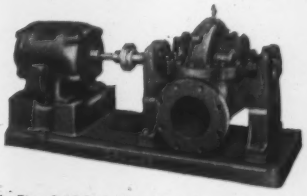
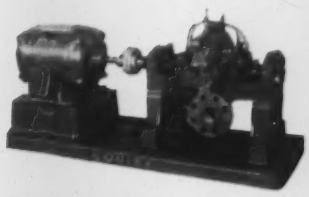
4. Cowl-type glands for use with quenching fluids.
5. Corrosion resistant gland bolts.
6. Stainless steel impeller keys.
7. Teflon water seal rings.

Because so many parts on these pumps are interchangeable—you can cut parts inventory in two or better.

For further information write for Bulletin 721.6 on the Fig. 3405; Bulletin 722.6 on the Fig. 3305.



Goulds Fig. 3405 single-stage pump.



Goulds Fig. 3305 two-stage pump.

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DESIGNERS

WHAT major organization offers continual original work assignments?

For the answer, turn to page 165

YOUR *New Catalogs* GUIDE

277 HELICAL SPRINGS

Union Spring & Mfg. Co.—A 48-page catalog, No. 6, contains engineering data and descriptions of helical springs, Belleville springs, stampings and steel castings from 1 to 7500 lb.

278 TURBINE SEAL

Koppers Company, Inc., Metal Products Div.—A 4-page folder on Huhn carbon rings for steam turbine applications discusses labyrinth, carbon garter spring ring and carbon ring sealing devices.

279 WATER HEATER

Patterson-Kelley Co., Inc.—A 12-page catalog, No. 6001, describes Type "DW" converter and water heater, employing forced circulation of boiler water and designed for use below the water line of a steam boiler or with a heating boiler. Heating capacities of from 2.2 gpm to 380 gpm may be specified from selection tables showing shell sizes, number of passes and available boiler water temperatures.

280 FANS, BLOWERS

Robinson Ventilating Co.—Bulletin 502 illustrates and describes fans, blowers, exhausters. Application photos are included, along with data on air properties, pressure and velocities.

281 ELECTRICAL PRECIPITATORS

Research-Cottrell, Inc.—Illustrated General Bulletin, 28 pages, describes Cottrell theory, methods, types, and specific applications in a variety of industries, including power, steel, chemical paper, metallurgical, gas, oil, and carbon black.

282 FLEXIBLE METAL HOSE

Atlantic Metal Hose Co.—Bulletin 21-A covers flexible helical corrugated hose manufactured from stainless steel and various alloys. Types A-1H and A-OH without braid and with as many as three braids for extremely high pressures and severe service are listed. Applications include conveying of corrosive gases and liquids, high temperature and pressure service, vibration absorbers, continuous flexing, loading and unloading. Assemblies are illustrated.

283 VALVES

Republic Mfg. Co.—Catalog No. 654A, 72 pages, illustrates and gives specifications on needle, globe, plug, check, relief, selector valves for industrial, chemical and aviation uses.

284 NEEDLE THRUST BEARINGS

Torrington Co.—A four-page folder describes a new needle thrust bearing. Incorporating data on the bearing's design, installation, lubrication and load capacity, the folder also gives dimensions and other detailed information about each bearing available. Typical needle thrust bearing applications are illustrated and described.

285 WATER WALL ARMOR

Bernitz Furnace Appliance Co.—Bulletin B-52 describes Carbofrax water wall tube armor. Installations are shown. The material can be installed in new or existing boilers without bolts or clamps to protect against mechnical and flame abrasion.

286 ASBESTOS-CEMENT BOARD

Philip Carey Mfg. Co.—Form 6285 describes asbestos-cement board for exterior walls, partitions, linings, utility structures. The material is not affected by most acids, alkalis, fumes, heat, cold, weather, salt air. It is vermin and rodent proof, will not rot, rust or corrode, and needs no paint or protective coating. It can be painted for decorative purposes. Suitable for continuous temperatures up to 600 F.

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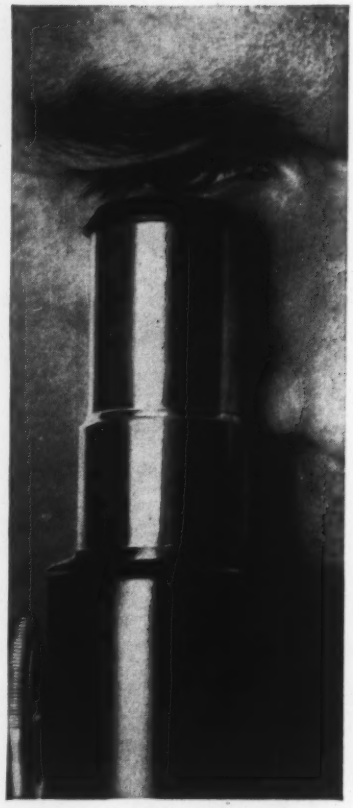

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LATEST INDUSTRIAL LITERATURE

287 SPRING DESIGN

Associated Spring Corp.—The fundamentals of spring design are set forth in an eight-page brochure. The brochure contains the basic stress and deflection formulas, the commonly used spring materials, typical applications, and certain limitations for each of the various types of springs. A tabulation of tensile, torsional and other physical properties of the commonly used spring materials, and notes on the process of manufacture and the chief uses of each is included.

288 GASKET MATERIAL

American Felt Co.—Literature describes the chemical and physical properties of Vistex with Teflon, a gasketing material. It has a tensile strength of 5000 psi, good cutting properties and is designed to resist fraying.

289 MOTION PICTURE CAMERAS

Wollensak Optical Co.—A catalog explaining high-speed photography, its application and the results obtainable and a folder describing the operation and uses of the Fastax high-speed motion picture-oscillographic camera are available. These cameras, used in research, design, commercial engineering, are a continuous moving film type with rotating prism positioned between the lens and the sprocket. They are available in 8, 16 and 35 mm in both 100 and 400 ft capacity.

290 SPHERICAL ROLLER BEARINGS

SKF Industries—Bulletin No. 443 discusses the company's improved (Type C) spherical roller bearing which is said to increase capacity 25 to 50 per cent and service life 2 to 3½ times. All bearings having a 140 mm or larger outside diameter also have a new lubricating feature in which the lubricant is channeled directly to the center of the bearing, completely covering all working surfaces. The booklet also lists several series of pillow blocks which are furnished with "C" type bearings, and a new line of "Take-Up" units.

291 DATA PROCESSING

Consolidated Electrodynamics Corp.—A 20-page catalog describing the firm's Datalab Div. tells of accomplishments in research, design and development of instrumentation for data processing.

292 POWER PLANT EQUIPMENT

Copes-Vulcan Div., Blaw-Knox Co.—Bulletin No. 1022A describes a line of power plant equipment which includes automatic combustion control, boiler feedwater control and soot blowing systems, desuperheating and pressure reducing stations, and rotary and retractable soot blowers. According to the bulletin, the firm offers a completely integrated system for the control of combustion, feedwater, steam temperature and boiler cleaning. It is available in a single package or as individual systems to meet specifications.

293 DEAERATORS

Permutit Co.—Bulletin No. 2357 describes the company's spray type deaerating heater. The principles of deaeration and the part it plays in corrosion prevention are described and illustrated. The deaerating heater is designed to protect equipment from corrosion by removing oxygen, carbon dioxide and nitrogen.

294 MISSILE FABRICATION

Alco Products, Inc.—A 20-page bulletin outlines engineering and manufacturing qualifications of Alco as a missile fabricator. It lists the company's association with electronic developments, its basic research facilities, and the acceptance of its thermal engineering systems for applications, incl. the "Honest John" rocket and "Terrier" missile.

295 FINISHED FORGINGS

Drop Forging Assn.—"What is a Forging?" is an eight-page folder that describes what physical changes take place when metal is transformed into a finished forging. Also described are advantages of producing metal parts by forging.

296 OPTICAL INSTRUMENTS

Bausch & Lomb Optical Co.—A booklet, "Industrial Optical Aids," contains information on an assortment of inexpensive precision optical instruments and suggests ways to use them to gain faster, easier, lower-cost production. Items discussed include magnifiers, microscopes, wide field tubes, macroscopes and comparators.

297 AIR DIRECTIONAL VALVES

Westinghouse Air Brake Co.—An eight-page catalog describes two-, three-, and four-way spool type directional valves with solenoid, lever, push button, pilot cylinder, cam, treadle and pedal operators. Valves have tapped exhaust or open exhaust. In neutral, spools close all passages, connect delivery passages to exhaust or connect delivery passages to supply.

298 PANEL ENGINEERING

Leeds & Northrup—A 12-page catalog illustrates and describes design and construction of centralized control boards for steam power plants. Application photos are included along with background and photos on the company's facilities for designing and installing control units.

299 AFTERCOOLERS, SEPARATORS

R. P. Adams Co., Inc.—A 12-page bulletin, No. 711, features aftercoolers and cyclone separators for compressed air and gases. Three color sectional drawings, charts and check list are designed to help determine the amount of moisture in compressed air lines.

300 BIN LEVEL CONTROLS

Bin-Dicator Co.—Catalog describes and illustrates bin level indicators including new Roto-Bin-Dicator and Bin-Flo aerator units. Dimensional drawings, mounting details, typical applications, wiring diagrams, and list of present users.

301 CENTRIFUGAL PUMPS

Pacific Pumps, Inc.—"The Choice, Design, Characteristics and Maintenance of Centrifugal Pumps" is a reprint in booklet form of three published articles.

302 PROCESS HEATING EQUIPMENT

Union Iron Wks.—A four-page folder illustrates and describes vaporizers and forced circulation liquid heating and cooling units for use in the process industries. Diagrams and dimension tables of the units are included.

303 PIPING SYSTEMS

Tube Turns.—A technical bulletin gives the allowable stresses as used in the formulas of the ASME Boiler Construction Code (1952), Section I, and in the ASA Code for Pressure Piping B31.1-1955. The objective of the various codes is to prescribe a standard of minimum requirements for safe design of piping systems in such fields as power industrial gas and air, oil, district heating, refrigeration and gas transmission.

304 LIQUID LEVEL ALARMS

Reliance Gauge Column Co.—Bulletin D2 describes a series of four liquid level alarms and optional fuel cut-outs. Illustrated text explains principle of operation—water conduction between electrodes of varying lengths—and how the units can be used with relays to provide alarm actuation, fuel cut-out, or pump start-stop control.

305 HEAT EXCHANGERS

Lummus Co., Heat Exchanger Div.—Bulletin M-306 includes a description of the design specifications and construction details of standard heat exchangers for process industries. Tables of effective surface area available, overall dimensions, thermal design data are included.

306 COAL VALVES

Stock Equipment Co.—An 8-page bulletin contains descriptive and dimensional data on a redesigned coal valve featuring self-cleaning racks and pinions, strong steel U-shaped gate and large ball bearing equipped gate supporting rollers. The valve is dust-tight. The gate offers lap closure on four sides and is well suited for applications in chemical processes, cement plants and other industries in addition to power plants.

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307 PRESSURE VESSELS

L. O. Koven & Bro., Inc.—Bulletin No. 550 illustrates and describes mixers, kettles, vacuum and pressure vessels, autoclaves, evaporators, impregnators, condensers, stills, extractors, tanks, standpipes, piping, stacks.

308 PROCESS CONTROL SYSTEM

Swartwout Co.—A bulletin covers equipment for an all-electronic control system for process and power instrumentation. It can be used with a-c, d-c or motion inputs, as well as the conventional primary elements. In addition to various components, a discussion of electronic transmission and control is included.

309 RING-LOCKED FASTENERS

Rosan, Inc.—Latest edition of 44-page catalog describes and illustrates patented Rosan locking principle. It shows applications, installation and removal procedures, and furnishes design data and dimensions necessary to select and use ring-locked inserts, studs and other threaded fasteners.

310 AUTOMATIC BAR MACHINE

National Acme Co.—A 10-page Catalog illustrates and describes the new Model M single spindle automatic bar machine, a universal, fully automatic metalturning lathe which can sustain fine tolerances at the fastest speed that tungsten carbide and high speed tools can be safely operated.

311 AUTOMATIC CONTROLS

Mercoid Corp.—Catalog Number 857, a 52-page reference book for engineers, contains information on automatic controls for pressure, temperature, liquid level, and mechanical movement. Transformer-relays and mercury switches are also listed.

312 CENTRIFUGAL FANS

Buffalo Forge Co.—Bulletin FD106 covers design, performance and application data on backward curved blade centrifugal fans. Dimensions are tabled.

313 POWER TRANSMISSION BELTS

Raybestos-Manhattan, Inc.—An illustrated brochure covers a new Poly-V belt drive, drawings show its design and operational advantages, and photographs of installations in various industries are included.

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314 CHART PAPERS

Technical Charts, Inc.—A bulletin includes 16 different bulletins describing specifications for special recording charts. Subjects of the bulletins include chart paper, special recording papers including heat sensitive and electro sensitive papers, roll chart core sizes, roll chart punch sizes and others.

315 PIPING DESIGN

Blaw-Knox Co., Power Piping and Sprinkler Div.—The design of piping for flexibility with Flex-Anal Charts is covered in an 86-page book. It fills the need for the flexibility analysis of any piping system. It is intended for the experienced pipe designer who can, by use of this method and the application of Flex-Anal Charts, accurately analyze most piping systems in a few hours which formerly required days and even weeks. Many tables, Flex-Anal Charts, and typical piping layouts are included.

316 WATER SOFTENERS

Cochrane Corp.—A 20-page publication, No. 4520, deals with the necessity for water softening, explaining the fundamentals of softening and selection of equipment and zeolites. The bulletin also describes the operation of the firm's hydromatic valve for manual or automatic control of the cycling of the process.

317 FIRED INDIRECT HEATERS

Brown Fintube Co.—Bulletin No. 551 covers the applications, advantages and types of fired indirect heaters for air, special atmospheres, corrosive and non-corrosive gases, thermal chemicals, circulating oils, asphalt, and for super heating vapors.

318 GEAR MOTORS

Sterling Electric Motors, Inc.—A 12-page colored bulletin describes Slo-Speed gear motors, separate motor speed reducers, and multi-mount speed reducers. Description of all products is given along with a technical discussion of engineering features. Bulletin includes technical information on how to select gear motors and speed reducers.

319 PLATE FORM MOUNTINGS

Lord Mfg. Co.—Bulletin No. 702 contains engineering data, performance curves, specification tables, details on the design and use of plate form and multiplane mountings to control steady state vibration plus occasional shock where excellent isolation characteristics and moderate restraint are needed. Load capacities range from 1/2 to 310 lb per mounting.

320 EXPANSION COMPENSATORS

Flexonics Corp.—Bulletin AIA No. 30-C-22 illustrates and describes expansion compensators for steam and hot water lines. Included is data on a high pressure type to 150 psi and a low pressure type to 40 psi.

321 CUSTOMIZED MOTORS

Jack & Heintz, Inc.—An eight-page booklet, "Design Your Product To Do a Job—Not to Fit a Motor," covers customized electric motors, and describes the firm's facilities for designing, testing, and producing special electric motors up to and including 3 hp.

322 VENTURI TUBES

Builders-Providence, Inc., Div. B-I-F Industries, Inc.—Design features, comprehensive dimensional data, capacity tables, recovery tables on venturi tubes are included in Bulletin 110-N1.

323 CONTROLLED-AIR-DEVICES

Bellows Co.—Bulletins BM-25 and ML-3 illustrate and explain air motors and the choice of built-in valves and auxiliary hydraulic controls available for them. Bulletin ML-3 also describes the basic types of complete-work-units, such as power feeds, work feed tables, drilling units. Both booklets contain application photographs.

324 MULTI-PURPOSE STEEL

Lukens Steel Co.—A 24-page bulletin describes the properties and handling characteristics of a new multi-purpose steel, T-1. Suggested uses include applications where extreme toughness and high yield strength are needed for economies in fabrication, payloads, maintenance and equipment life.

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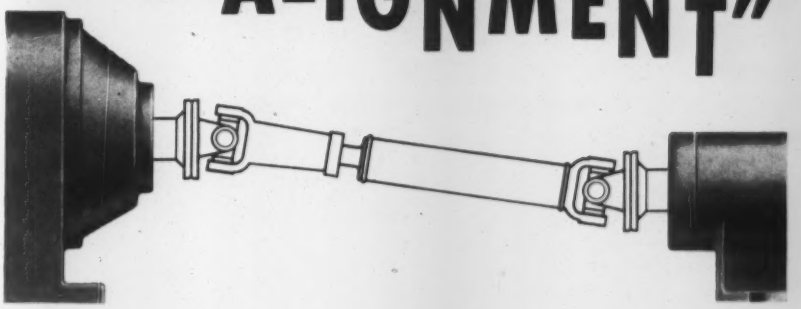

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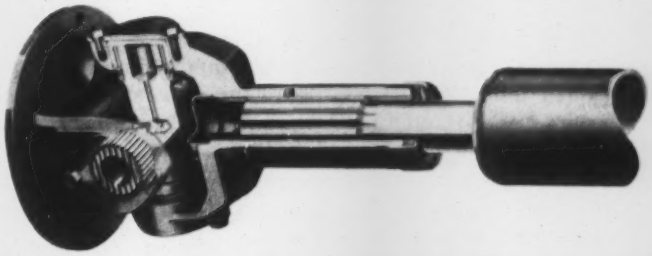

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325 LENSES, PRISMS

Bausch & Lomb Optical Co.—A 16-page catalog of optical parts contains information on ground glass, heat absorbing glass, retardation plates, and the firm's precision glass engraving and optical coating services. A new price list detailing up-to-date individual part prices, discount procedures, minimum ordering quantities, and terms of sale is included.

326 GENERAL BULLETIN

W. C. Dillon & Co.—A 6-page folder illustrates and describes overload switches, universal testers, mechanical force gages, dynamometers, thermometers and weight indicators.

327 ELECTRICAL HEATING UNITS

Edwin L. Wiegand Co.—Booklet illustrating and describing 101 ways to apply electric heat and showing approved methods of electrically heating liquids, air, gases, machine parts and process equipment. All items are illustrated and described in detail and varied applications are shown. The heating units go under the trade name of chromolox.

328 LIQUID COOLED COUPLINGS

Dynamatic Div., Eaton Mfg. Co.—Bulletin WC4 gives a detailed discussion of the application, characteristics and construction of liquid cooled couplings. Standard units range from 15 hp at 1700 rpm through 1000 hp at 1100 rpm. Couplings can be provided in other sizes up to 20,000 hp.

329 BOILERS AND STOKERS

James Leffel & Co.—Bulletin 236 gives descriptive and specification information and performance data on the firm's gas-, oil-, and coal-fired heavy-duty Scotch boilers and on underfeed stokers for use with Scotch boilers.

330 KILN INSTRUMENTATION

Leeds & Northrup Co.—A 16-page folder illustrates and describes instruments and controls for rotary kilns used in the manufacture of cement, lime and other non-metallic products. Installation photos are included.

331 HUMIDITY CONDITIONING

Kathabar Div., Surface Combustion Corp.—An 18-page booklet shows applications of humidity control equipment in various industries. Problems, solutions and results of 12 case histories are included, along with data on how the system works.

332 FUEL CELL FASTENER

Waldes Kohinoor, Inc.—A 7-page catalog provides engineering data and specifications for the company's Waldes positive lock fastener, which is used to hold airplane fuel cells in place without piercing the cell wall on installation. Illustrations and charts explain the use and method of application for the device.

333 QUICK OPENING DOORS

Struthers Wells Corp.—Bulletin SW-553 covers quick opening doors for processing equipment. Automatic or semi-automatic in operation, the units are available in Ring-lok or Wedg-lok types, designed for vulcanizers, devulcanizers, impregnators, sterilizers, cement block curing vessels, ovens, and creosoting cylinders.

334 UNDERGROUND PIPE INSULATION

American Gilsonite Co.—A four-page Bulletin gives tips on the uses and installation of a new insulation for hot underground pipes. It explains how the material protects pipes against corrosion caused by acids and alkaline ground waters, and against bacterial action, roots and electrolysis.

335 EFFECTS OF CHECK VALVES IN OVERCOMING WATER HAMMER

Williams Gauge Co.—The cause, effect, and control of water hammer in piping systems are considered in an 8-page bulletin. After describing water hammer in nontechnical terms, the brochure indicates its potential damage to piping, instruments, and other parts of water systems, and considers methods of controlling it.

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336 LABORATORY PRESSES

Wabash Metal Products Co.—A four-page bulletin describes the line of manually operated and powered hydraulic laboratory presses from 3 to 50 tons capacity. Heated platens, sensitive pressure and temperature gages, applications, typical uses and construction features are described.

337 ROLL FORMED SHAPES

Roll Formed Products Co.—A 26-page catalog covers the production of roll formed shapes. Processes shown include notching, punching and cutting to length of special shapes in one continuous operation. Also included are drawings and dimensions of more than 100 simple and complex shapes.

338 INDUSTRIAL PLASTICS

H. N. Hartwell & Son.—Catalogs and technical bulletins describe Boltaron 6200 corrosion resistant unplasticized polyvinyl chloride sheet, pipe pipe fittings, valves, bars, blocks, and welding rod, as well as Boltaron 7200 modified high impact PVC sheet and pipe materials.

339 AIR COCKS

Westinghouse Air Brake Co.—A four-page catalog illustrates and describes plug type and diaphragm type two and three-way cut-out cocks for pneumatic systems.

340 INTERFEROMETER

Link Aviation, Inc.—A leaflet is available describing the Link Fringecount micrometer which is a measuring device using the light interference principle. Measurements up to two inches are possible, with accuracy claimed of one millionth of an inch. Gage blocks, plug gages, and ball and roller bearings measured.

341 POOL FILTERS

R. P. Adams Co., Inc.—A 24-page bulletin, No. 625, describes swimming pool filters. This firm specializes in filters for large size pools only.

342 REFERENCE JUNCTION

Pace Engineering Co.—A data sheet describes a thermostatically controlled temperature reference for multi-channel thermocouple systems. Specifications include temperature stability and uniformity among thermocouple reference junctions as well as descriptions of special circuit features and thermocouple combinations. A complete control system for oscillographic recording is also described.

343 TECHNICAL BOOKS

D. Van Nostrand Co., Inc.—Catalog of books on science, technology, medicine, and business for 1957 includes nearly 1000 new and current books including the "Geneva Series on the Peaceful Uses of Atomic Energy" and "Principles of Guided Missile Design." Fields such as atomic energy, engineering, mechanics, physics, mathematics, chemistry, metallurgy, aeronautics are covered.

344 GEARMOTORS, MOTOGEARS

Link-Belt Co.—A new line of gearmotors and Motogears is described in 28-page Book No. 2447, which includes complete selection data together with features of construction, load classifications, dimension tables, overhung load ratings and mounting assemblies. Both designs are in keeping with new NEMA motor sizes.

345 QUENCHING OIL

Gulf Oil Corp.—A 24-page brochure, "Gulf Super-Quench," describes function of dual-action quenching oil for a wide range of steels. It explains mechanism of heat removal, effect of variation in bath temperature, degree of agitation, mass effect on depth of hardening. Charts and curves depict comparison with several quenching media. Tests to determine depth of hardness, distortion and cracking are discussed.

346 PACKAGED STEAM GENERATORS

Superior Combustion Industries, Inc.—Packaged fire tube steam generators are described in detail and with illustration in a 16-page catalog with a special foldout cover. Data, dimensions and specifications for units in 18 sizes from 20 to 600 bhp and for operation burning oil or gas or both are included.

347 CYLINDERS

Ledeen Mfg. Co.—A 12-page bulletin illustrates and describes the company's line of cylinders for air, oil, water, gas or steam operation in medium, heavy and super-duty construction. Selection information, ratings and limitations, and rod and head attachments are included.

348 HEAT EXCHANGERS

Pfaudler Co.—Manual No. 837 illustrates and describes the firm's new standardized alloy designs of shell and tube equipment for application in the chemical and food industries. This equipment may be installed for any of the following uses: condensers, heat exchangers, heaters, evaporators, coolers and reactors. Selection data, system diagrams, specifications, construction, installation, operation and maintenance information is included.

349 PNEUMATIC CONVEYORS

National Conveyors Co.—Catalog P-56 shows uses of pneumatic conveyors for ash removal in steam plants; collection, processing and reclamation of cutting oils, chips, and borings in the metal working industry; and the handling of dry, pulverized or granular materials in other industry.

350 STUD WELDING

Nelson Stud Welding Div., Gregory Industries, Inc.—A manual covers designing, materials, specifications, dimensions and physical properties of the materials used in the Nelweld method of welding studs.

351 DATA SYSTEM

Beckman Instruments, Inc., Scientific Instruments Div.—A 16-page brochure illustrates and describes Model 111 data system, a unit used as a link between sensing elements and computer in chemical processing industries. Other applications include pilot plants, weather logging, atomic reactor monitoring, testing.

352 BOILERS, GENERATORS

Erie City Iron Works.—A 16-page condensed catalog, No. SB-50 offers a line of boilers and allied equipment, including custom engineered and standard water and fire tube steam generators. Underfeed, spreader, traveling grate stokers and pulverizers are cross sectioned. Waste heat boilers, water walls, superheaters, economizers and air heaters are also shown.

353 TANK, VESSELS

Nooter Corp.—A 48-page Catalog No. 554 describes facilities, workscope, techniques in custom fabrication of steel and alloy plate for processing industries. Corrosion data tables for various metals are included.

354 LUBRICATORS

Manzel Div., Houdaille Industries, Inc.—A series of bulletins illustrates and describes force feed lubricators, spray lubricating systems, high pressure lubricators, pulsolators, chemical feeders, a 10-ton bench or portable arbor press, and slurry pumps.

355 ULTRASONIC TESTER

Sperry Products, Inc.—An eight-page bulletin covers applications of the ultrasonic Reflectoscope for nondestructive testing of products and equipment. It explains in simplified terms the principle of ultrasonic inspection and lists the latest types of equipment available.

356 CONVEYOR SYSTEMS

Fuller Co.—Bulletin G-3, eight pages, pictures and describes pneumatic conveying systems built by the company for handling dry, pulverized and granular materials. Diagrams showing how systems work are included. Also illustrates and describes rotary compressors and vacuum pumps, inclined-grate coolers and Humboldt preheater for handling dry, granular materials.

357 FLEXIBLE METAL HOSE

Atlantic Metal Hose Co.—Bulletin 20-E covers corrugated flexible metal hose of annular and

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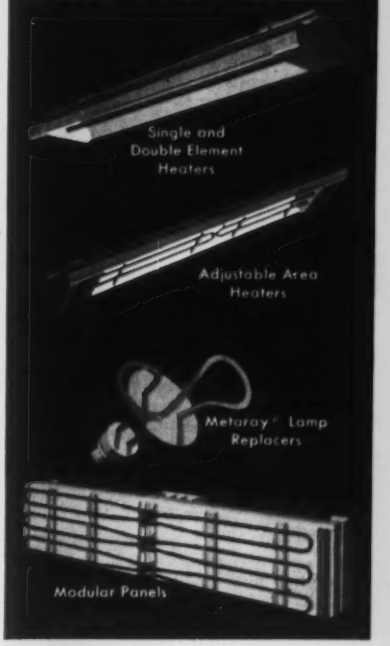

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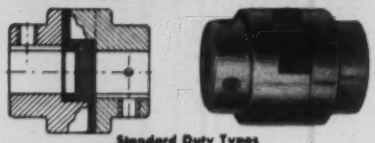
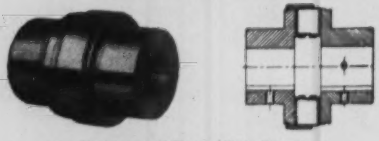
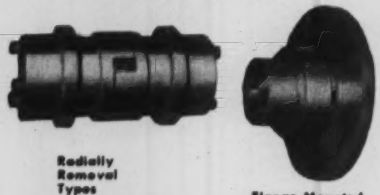


Standard Duty Types
.05 to 40 hp. at 1750 rpm.



Medium and Heavy Duty Types
2.6 to 810 hp. at 100 rpm.



Radially Removal Types
1.9 to 30 hp. at 100 rpm.— 2 to 40 hp. at 1800 rpm.

Flange-Mounted Types
11 to 740 hp. at 900 rpm.

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- No lubrication required.
- Simple, rugged construction—few parts and no intricate mechanisms.
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- Cushions are engineered to the load and service conditions.

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helical construction. Steel and bronze hose, with and without metal braid couplings and assemblies are described. Applications listed are for vibration absorbing, misalignment connecting, high pressure use, oil burner and gas furnace connections, handling compressed air, steam, solvents, chemicals, refrigerants, gasoline, searching liquids, caustics, ammonia.

358 AUTOMATIC CONTROL

Assembly Products, Inc.—Catalog 4-C illustrates and describes principles of automatic control with contact meter-relays. Included are specifications and prices on meter-relays, VHS relays, load relays and plug-in units, automatic control packages and components, panel meters, indicating pyrometers. A 6-page section of diagrams and text deals with circuitry and includes response time tables and a discussion of non-locking contacts.

359 CASTERS

Roll Rite Corp.—A new line of casters in 6, 8, 10 and 12 in. sizes featuring a patented "Self-Energizing" wheel, is described in Catalog No. 301. The casters are rated by drawbar pull required.

360 FORGINGS

United States Steel Corp.—A booklet illustrates and describes the manufacture and application of generator, turbine and waterwheel forgings, anvil bases and columns, forged shafts, forged steel rolls and sleeves, forged blooms, billets and rounds, and miscellaneous forgings. A history of forging is included in the booklet.

361 PACKINGS, GASKETS

Crane Packing Co.—A 12-page booklet illustrates and describes the firm's Teflon mechanical and hydraulic packings, sheets, rods, tubing, tape, flexible bellows, gaskets, custom molded and machine parts, electrical and electronic parts.

362 FLEXIBLE COUPLINGS

American Flexible Coupling Div., Zurn Industries, Inc.—Twelve-page Form 12 contains case histories on power transmission applications using Amerigear couplings. Included are applications in heavy mill service, high-speed turbines, hydraulic presses, power supplies.

363 ANALOG COMPUTING COMPONENTS

George A. Philbrick Researches, Inc.—A 16-page catalog covers line of electronic analog computing components. It graphically demonstrates the use of the modular concept in building a computor installation.

364 O-RINGS

Precision Rubber Products Corp.—A 52-page handbook covers O-rings and Dynaseal packings. Included is data on the company's facilities, non-moving and moving seals, military approved O-rings, compounds, back-up rings, and seals and rings for a variety of applications.

365 PRESSURE REDUCING VALVES

Spence Engineering Co.—A four-page bulletin describes two models of direct-operated water pressure reducing valves for dead-end water service where flow is intermittent and subject to abrupt fluctuation. Pressures range from 30–80 psi and 10–50 psi.

366 AUTOMATIC FILTERS

R. P. Adams Co.—Automatic filter for complete industrial automation is covered in new three-color bulletin. Dimension charts of three sizes, and flow graphs covering capacity with Poro-Stone, Poro-Screen and Poro-Edge elements given. Four-color operation drawings given. Current installation photographs shown.

367 OIL AND GAS BOILERS

S. T. Johnson Co., Mears, Kane, Ofeldt, Inc. Div.—Bulletins 2-L, 6-H, 7-D and 4-H cover line of gas, oil and combination oil and gas fired boilers from 1 to 30 hp, with the necessary automatic boiler feeds.

368 WELDING ALUMINUM

Aluminum Co. of America—A 176-page hard cover book gives basic, practical data on the various processes for welding aluminum with special emphasis on the inert gas methods. Included

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is guidance in selecting the process and the alloy. One chapter is devoted to the performance of welds. The book is profusely illustrated and contains 32 tables.

369 TORQUE CONTROL

Ingersoll-Rand Co.—Form 5170 describes two new torsion bar torque control Impactools designed for running nuts to prescribed torques. When desired torque is reached, the tools shut off automatically. Two sizes are available, the 5040T for torques up to 90 ft-lb, and the 5340T for torques up to 550 ft-lb. The tools may be quickly set to prescribed torques with easy-to-use jigs.

370 HYDRAULIC PRESSES

Lake Erie Engineering Corp.—Bulletin 1.1 describes hydraulic presses and die casting machines. It incorporates a comprehensive chart relating various types of presses to their production uses. Photos of representative presses and a selection chart are included.

371 COMBUSTION EQUIPMENT

Todd Shipyards Corp., Products Div.—Literature describes various types of oil, gas, and combination burners, asphalt heaters, thermo air heaters, package burner units, combustion chambers, pressure vessels, pumping, heating and straining units, TIFA—Todd insecticidal fog applicators.

372 AUTOMATION DRIVES

Reliance Electric & Engineering Co.—Bulletin A-1555-B illustrates and describes variable speed drives, motors, generators, gearmotors and controls for aiding automation in industry.

373 DRAFTING MACHINES

Charles Bruning Co.—"The Finest in Drafting Machines," a 20-page illustrated booklet, explains the cost and time-saving advantages offered by drafting machines in mechanical drawing, and describes and illustrates models and construction features. A list of available scales is included.

374 ALUMINUM CASTINGS

Morris Bean & Co.—A booklet on "The Antioch Process" offers a brief technical description of the mold making process developed by Morris Bean and used currently in the production of aluminum castings. Loose specification sheets covering applications of the process in aircraft parts, tire molds, electronics fluid flow and miscellaneous castings are available.

375 TECHNICAL BOOKS

Lefax Publishers—Over 2000 listings of Lefax pocket-size technical books are contained in the newly revised 1957 Lefax list of technical data sheets. Condensed, mathematically accurate source materials for engineers, construction men, technical workers, and technical students. Each book consists of approximately 140 pages of easily read tables and data in pocket-size, loose-leaf form for handy reference right on the job.

376 TRACING PAPER

B. K. Elliott Co.—Literature describes "phantom grid" lines designed to facilitate sketching and scale drawing and drop out completely in blueprints and whiteprints. The firm says erasing and correction leave no trace on the paper, called Ellco-Vel.

377 SPRAY COATING

Metallizing Engineering Co., Inc.—Bulletin 126A describes and shows typical applications of the firm's Thermospray process for hard surfacing. This entails self-fluxing, boron-silicon alloys, sprayed in powder form without compressed air, torch-fused, semi-fused or unfused to meet exact hand-surfacing requirements.

378 METERS, CONTROLS

Bailey Meter Co.—More than 100 measuring, transmitting, receiving, recording, and indicating instruments and control components for power and process applications are described in an 8-page bulletin G15-1. Included are references for each product and 24 instrument and control applications. Addresses and phone numbers of all district offices also listed.

379 AIR COMPRESSORS

Gardner-Denver Co.—An eight-page bulletin illustrates and describes carbon piston horizontal single-stage air compressors for oil-free air in the processing, chemical and plastic industries.

380 HEATERS

Dravo Corp.—Bulletin 552, 563 and 564 cover the firm's forced air space heaters for comfort heating, year-round ventilating, tempering make-up air, process drying, heat curing. The units are direct fired by oil, gas or combination fuels.

381 DIAPHRAGM VALVES

Grinnell Co.—An 8-page catalog describes diaphragm valves offering streamlined fluid passage, flow control, leak-tight closure. Isolation of working parts from fluid stream is said to prevent product contamination and corrosion of operating mechanism. Flexibility of assembly and wide choice of materials for bodies, body linings and diaphragms are described.

382 CHROMIUM PRODUCTS

Van der Horst Corp.—A bulletin covers, in question and answer style, the properties and application of the firm's Porus-Krome, a pure hard chromium applied to cylinder bores and other bearing surfaces by a process which produces pores to hold lubriacting oil.

383 SPREADER STOKERS

Hoffman Combustion Engineering Co.—Catalog No. 55-CAD describes and illustrates features of moving-grate spreader stokers. Catalog 55-PDG describes, illustrates, and supplies additional information on spreader stokers with dumping grates. Capacities from 20,000 to 500,000 lb of steam per hr.

384 STEEL DOORS

Kinnear Mfg. Co.—Bulletin No. 93, 32 pages illustrated, covers steel rolling and other types of Kinnear Doors. One section describes a galvanized steel sectional overhead-type door that combines durability with operating convenience; facilities for glass light-sections in a door for commercial and industrial service openings are offered. Also details, clearance requirements, and accessories.

385 STREAMLINED BAFFLES

Engineer Co.—Bulletin BW-54 shows the design and describes the construction of streamlined baffles for many types of water tube boilers for various furnace designs and methods of firing.

386 ELECTRIC WELDED TUBING

Jones & Laughlin Steel Corp.—Literature gives specifications and characteristics of Electricweld tubing and its application on automobiles and in bicycle and furniture frames.

387 PUMP CONTROL

McDonnell & Miller, Inc.—A bulletin illustrates and describes the firm's 91 series for installations up to 150 psi and 92 series for installations up to 250 psi of magnetic switching pump control, low water cutoff and alarm switch.

388 LIQUID METERS

Buffalo Meter Co.—Catalog of Niagara Industrial Meters, Bulletin No. 37 describes the company's line of volumetric meters for industrial liquids including chemicals, oils, solvents, hot water, cold water, syrups, acids, and alkalies. Automatic batch-measuring equipment is described.

389 CONVEYOR-ELEVATORS

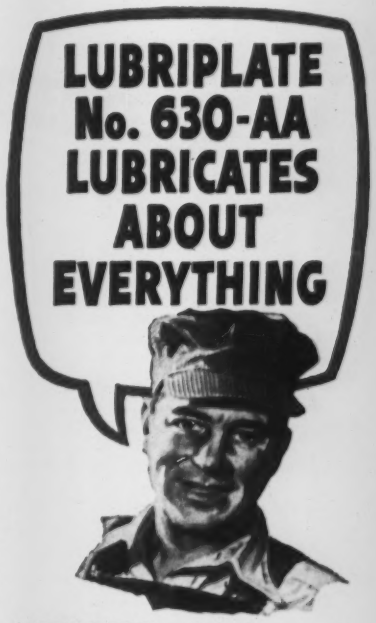
Stephens-Adamson Mfg. Co.—Catalog 556-T illustrates the firm's line of conveyors, elevators. Typical arrangements are diagrammed; power requirements, specifications and installation data is given. Applications in various industries are illustrated and described.

390 BRONZE BEARINGS

Johnson Bronze Co.—A catalog lists and illustrates more than 900 sizes cast bronze bearings, 400 sizes of bronze bars, cored and solid, graphited bronze, powdered bronze in straight, flanged and self-aligning bearings, bearing babbitt.

391 FILTERS, FILTER ELEMENTS

Cuno Engineering Corp.—Catalogs cover Micro-Klean replaceable filter elements, Flo-Klean automatic self-cleaning wire-wound filters, Poro-Klean porous stainless steel media for filtration, and Micro-Klean filters for air line service.



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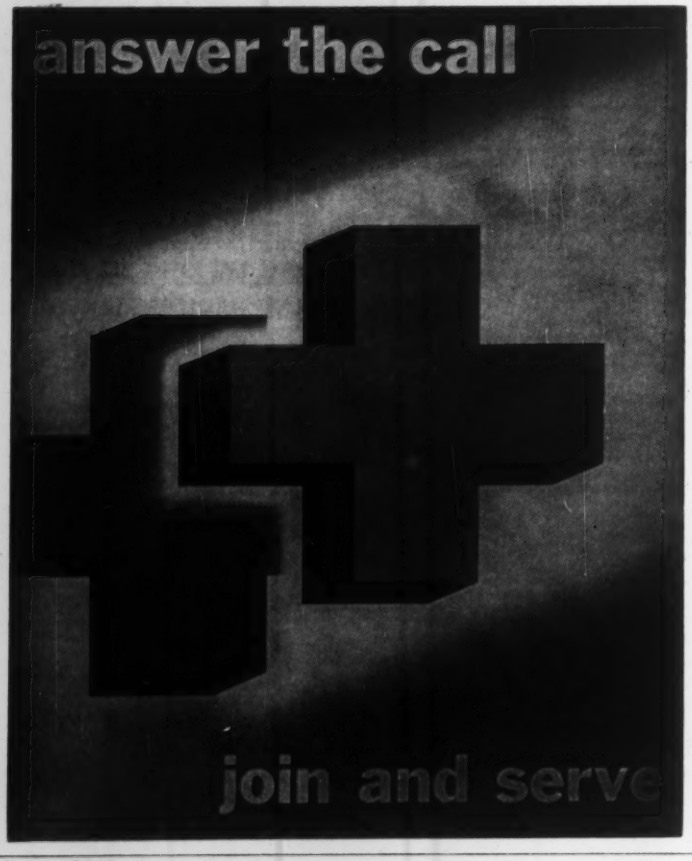

YOUR *New Catalogs* GUIDE

392 GLASS FIBER INSULATION

L-O-F Glass Fibers Co.—Illustrated brochures outline advantages of both Microlite and Superfine glass fiber insulations, low-density resilient insulating materials with high thermal efficiency and round absorption characteristics. They are described as being resistant to heat, fire, moisture, and corrosion and the company recommends their use in applications where the greatest thermal and acoustical efficiency is desirable in the smallest space. Tables are included on thermal and acoustical performance.

393 VIBRATING FEEDERS

Carrier Conveyor Corp.—Natural frequency mechanical vibrating feeders are illustrated and described in Bulletin No. 1001. No complicated electrical equipment is used in these feeders which come in standard widths to 72 in. and lengths to 12 ft. Special high temperature models for 1800 F material are available. All models are available with fixed or variable feed rate drives.

394 PLANT CLEANING GUIDE

Oakite Products, Inc.—Booklet F 9394R2 incorporates charts of equipment, cleaning methods, solutions, concentrations, temperatures, cleaning equipment. It covers cleaning, descaling, derusting, paint stripping, rust prevention, sanitizing, treatment of water in humidifying, air conditioning, refrigerating units. Steam and hot spray cleaning devices are described.

395 HEAT EXCHANGERS

Griscom-Russell Co.—Bulletin 1401 describes the twin G-Fin section heat exchanger, with longitudinally finned tubes for maximum heat transfer between dissimilar fluids, and for use on heating, cooling and condensing services. Design details, representative installations, complete specifications and dimensions are included.

396 GRAPHITE-CARBONS

Morganite, Inc.—A catalog includes a general compilation of the types of graphite-carbons manufactured by the firm to customer specifications. It includes do's and dont's for designers, physical characteristics of materials and specific aids on such applications as bearings, piston rings and vanes.

397 MATERIALS HANDLING

Jeffrey Mfg. Co.—Catalog No. 860 describes experience covering nearly three-quarters of a century, studying handling and processing problems of industry and designing and manufacturing machinery to meet them. The results of service to many types of industries are embodied in this catalog. Describes full line of conveyors, feeders, gravimetric weighers, crushers, shredders, barrel packers, coolers, dryers, magnetic separators, screens, transmission machinery, elevators, power scoops, electronic controls, bin level indicators, rotary bin check valves, car pullers, chains and sprockets.

398 PACKINGS, OIL SEALS

International Packings Corp.—Revised 60-page illustrated catalog and manual 201B covers all types of leather and synthetic rubber packings for hydraulic and pneumatic applications. Information on types, applications and dimensional data of cups, flanges, U and V packings, custom-engineered oil seals, O-rings and other precision molded products.

399 SAFETY MARKING TOOLS

M. E. Cunningham Co.—Catalog No. 100, 28 pages, illustrates and describes more than 100 different marking tools and devices. Also included is information on Mecco safety steel, a specially-developed alloy which is said to reduce spalling and mushrooming, and to increase marking life.

400 INDUSTRIAL PRODUCTS

American Brake Shoe Co.—First complete catalog, 48 pages, 2 colors, illustrates representative parts produced by eleven divisions of the company and details physical properties or characteristics. The catalog contains sections on ferrous castings, non-ferrous castings, bearing materials, sintered metals, steel forgings, welding products, air compressors, industrial pumps, dredge pumps, and railroad products.

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LATEST INDUSTRIAL LITERATURE

401 STEEL BOILERS

National-U.S. Radiator Corp., Pacific Steel Boiler Div.—A 24-page catalog, AP-364, features the entire line of Pacific Steel Boilers for medium to large size installations as well as SBI table 1 boilers for commercial applications are featured.

402 BLOWERS, EXHAUSTERS

Roots-Connersville Blower Div., Dresser Industries, Inc.—Sectional views, typical installations, performance characteristics, specifications and illustrations of large rotary positive displacement blowers and exhausters are included in Bulletin RB-154. Smaller units are featured in Bulletin AF-154. The units are available 5 to 50,000 cfm, 1/4 to 10 lb gage pressure or equivalent vacuum.

403 PRESSURE LOSS CALCULATOR

Golden Anderson Valve Specialty Co.—A slide calculator indicates pressure loss for steam valves. Included is data on super heated steam and equivalent lengths of standard pipe for globe and angle valves.

404 PRESSURE GAGES

Norden-Ketay Corp., Instrument & Systems Div.—Four-page Bulletin 430A has specifications of Ban-drive series of gages and standard ranges. Gages are offered in flush and wall mounting.

405 DRAFTING EQUIPMENT

Universal Drafting Machine Co.—Three bulletins on drafting equipment cover design advantages of civil engineer machines, selection of scales, and the Boardmaster, a machine capable of horizontal, sloping and vertical operation.

406 METALLIZING APPLICATIONS

Metallizing Engineering Co., Inc.—Bulletin 51C, eight pages, gives case histories and application data on metallizing applications in production, salvage and corrosion prevention.

407 SELF-CLEANING CENTRIFUGE

Pfaudler Co.—Bulletin 930 presents information on its Titan superjector, an automatic self-cleaning centrifuge. Engineering information, specifications and application data are given, along with details on the operation of the unit.

408 POWER SUPPLY

Pace Engineering Co.—A bulletin describes a regulated d-c power supply which is of the same size and may be substituted for 1.5 v dry cell batteries in self-balancing potentiometers and pyrometers. The regulating system is described briefly and specifications are given for stability against line voltage and other ambient variations.

409 ROOF VENTILATORS

Clarage Fan Co.—Bulletin 550 covers the new Centrilator, centrifugal type power roof ventilator with Jet Siphon feature for stable, high efficiency and quiet operation. Capacities and dimensions shown for 10 standard sizes. Units are constructed for static pressures to 2 in., capacities to 26,400 cfm.

410 HOT WORK DIE STEEL

Firth Sterling, Inc.—A brochure covers elevated temperature physical properties and typical analysis on hot work die steel. Two graphs on elevated temperature physical properties are included. These HWD grades are capable of meeting aircraft specifications for structural parts where heat is a factor.

411 CHROMATIC THERMOMETERS

Curtiss-Wright Corp., Research Div.—A folder describes Thermochrom colored crayons used to indicate instantaneously the temperature of hot objects. Marks made by the crayons change color at specific temperatures. Eighteen crayons indicate temperature in the 149 F to 1238 F range.

412 FLOAT, THERMOSTAT VALVE

Velan Valve Corp.—Catalog 600 illustrates and describes Velan monovalve float and thermostatic steam trap, a combination of the accepted float principle combined with the firm's bimetallic principle, with integral strainer, check valve and a single discharge valve instead of two or three as used in other valves.

413 WELDING FITTINGS

Bonney Forge & Tool Wks., Welding Fittings Div.—Catalog W-4 outlines details and specifications on Weldolets, Thredolets and socket Weldolets, welding fittings designed for every type of piping service. Engineering data, including temperature-pressing ratings, is included. An additional data sheet covers new drop-forged Elbolets with full penetration weld.

414 AERODYNAMIC RESEARCH

Hagan Chemicals & Controls, Inc.—Bulletin MSP-133 illustrates and describes the company's automatic controls for surge, altitude, mass flow, pressure, temperature position in aerodynamic research and testing applications. Application photos, diagrams and tabular summaries of the components are included in the bulletin.

415 GAS TURBINE ENGINES

Solar Aircraft Co.—A brochure describes the company's 50 hp Mars gas turbine engine and 500 hp Jupiter gas turbine engine. The Mars is a constant speed engine which operates at approximately 40,000 rpm and is used in airborne generator sets, portable fire pumps and air bleed compressors. The Jupiter is available in constant speed, variable speed and air bleed versions. It has been used to power small personnel craft, to drive generator sets and to provide compressed air for jet engine starting.

416 ROOF VENTILATORS

Buffalo Forge Co.—A 24-page bulletin, FM-2345, presents a pictorial record of case histories of heavy-duty propeller fans and related package units, roof ventilators, condensers, evaporators.

417 ADJUSTABLE-SPEED DRIVES

Dynamatic Div., Eaton Mfg. Co.—Data Sheets DS 1, 2, 3, 4 and 5 describe a new line of stationary-field, air and liquid-cooled drives that provide infinitely adjustable speeds from an a-c power source. Included are integral, motor and coupling combinations from 3 to 75 hp and separately mounted couplings up to 2,000 hp.

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Look over this listing of free catalogs. Then choose those that will be most helpful to you. Fill in coupon on page 42 and mail promptly. America's leading manufacturers make this literature available to you (except students).

418 AIR GAGES

Sheffield Corp.—Precisionaire catalog IPC 6-56 has 12 pages describing principle and application of air gaging with column-type instrument. It features basic tooling for inspecting internal and external dimensions and conditions, and types and sizes of adjustable air gage tooling. Illustrations of single and multi-dimension gage applications are included.

419 SILICONE RUBBER COMPOUNDS

Acushnet Process Co.—Literature describes silicone rubber compounds and expanded services for the molding of precision parts now available from the company. Increased service temperatures to 500 F and for limited periods to 600 F are offered by five new compounds. Three compounds with low shrinkage characteristics in the 50 to 70 durometer range permit molding of parts and holding of close tolerance in existing tools.

420 RECORDING CHARTS

Technical Charts, Inc.—A new 12-page catalog outlines services in producing recording charts for standard and special instruments. It includes samples of both dial and roll type charts. The method of production of over 8000 different standard charts is outlined. Technical information is given on requirements for special charts.

421 COMBINATION OIL-GAS BURNERS

Anthony Co.—Data Sheet BG-H describes Nebulyte combination oil-gas burner, and includes capacity table, selection chart graph, dimension drawings and typical layouts of burners and accessories. Also available are Data Sheets BA, BD and BL covering low and high-range industrial oil burners and Bulletin 501 on a proportioning burner.

422 RETAINING RINGS

Eaton Mfg. Co., Reliance Div.—A catalog describes the design and application of the firm's line of snap bearing lock and retaining rings, spring lock washers, spring washers preassembled on bolt or screw—self tapping screws, one-piece hose clamp.

423 MECHANICAL DEVICES

Hartwell Co.—A brochure outlines the company's facilities for product development, engineering and precision manufacture of mechanical devices. Illustrated are the company's test and development laboratory and experimental machine shop.

424 GRATINGS, STAIR TREADS

Dravo Corp., Machinery Div.—Bulletin 1105 illustrates and describes aluminum, diagonal, radial, rectangular and serrated grating, stair treads, and special metals, fasteners, and construction of these units for industry. Selection and application information is included.

425 ROLLER BEARINGS

Torrington Co.—New drawn cup roller bearing is described in six-page catalog. Detailed data on bearing design, installation, lubrication and load capacity are included, together with information on sizes available. Design features and typical applications are illustrated and described.

426 BOILER, TANK CONTROL

Commercial Shearing & Stamping Co.—Four catalogs are offered. Catalog P-2 covers products for boiler and tank manufacture; H-7 oil hydraulic fluid power controls—pumps, valves, cylinders, motor; P-3, standard shapes which are available without tool and die charges; G-1, applications and advantages of stampings, forgings and assembled products.

427 RADIO PRODUCTS

Panoramic Radio Products Inc.—A catalog digest contains condensed information on standard instruments for applications requiring high speed spectrum or waveform analysis. Included are sonic analyzers, sonic response indicator, signal alternator, triangular wave generator, ultrasonic analyzer, response indicator, sweep generator, spectrum analyzers, band-pass amplifier, oscilloscope cameras.

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LATEST INDUSTRIAL LITERATURE

428 GAS AND AIR COMPRESSORS

Cooper-Bessemer Corp.—Bulletin M-70, 40 pages, presents M-line compressors for transmission of gas and air. Installation photos show these units in use on pipelines, in refineries and chemical plants, and uses for air compression in industry. Cross sections and cutaways are included for many of the available types.

429 PRESSURE FILTERS

Cochrane Corp.—Publication 6319-20 describes vertical pressure filters, positive full-proof filter control for use in the industrial plants, hospitals, schools and many types of industrial applications. Publication 6322 describes the horizontal type pressure filter.

430 FIBERGLAS PANELS

Resolite Corp.—A 20-page brochure illustrates methods of application of standard and fire retardant Fire-Snuf Fiberglas panels for plant daylighting through roof and wall, in most standard industrial building construction assemblies. Details of end lap and side lap fastenings, and methods for shatter-proof sash glazing.

431 TRANSDUCERS

Consolidated Electrodynamics Corp.—A 32-page folder, No. 1552, on transducers and associated equipment, illustrates and describes vibration pickups, velocity pickups, torsiographs, pressure pickups, dynamic pressure pickups, accessories, suggested handling and mounting methods, pressure-conversion table and other data.

432 NAMEPLATE MARKING

Jas. H. Matthews & Co.—An eight-page bulletin illustrates and describes nameplate marking equipment from steel hand stamps to production machines.

433 FLEXIBLE METAL HOSE

Flexonics Corp.—A 12-page catalog covers line of Flexon flexible metal hose. The three main types of flexible metal hose and their specifications are given, typical applications are told, couplings available described, and a chart on how to select metal hose is included.

434 SPECIAL ALLOY STEEL

Jones & Laughlin Steel Corp.—A 40-page booklet contains case histories of Jalloy heat treated special alloy steel plate in such uses as trailer bodies, ore chutes, shovels and dipper sticks, picking tables, structural members, hammers, grader blades, dump truck, bottom line plates.

435 MAGNETIC DRIVES

Whitney Chain Co.—Data on design, drive features, operating and performance curves, output torque rating dimensions, selection chart, as well as photographs of installations and applications of magnetic drives are included in the brochure. The new self-contained permanent magnet type magnetic drives are described as fitting new NEMA frame specifications and range in horsepower from 1 to 15.

436 SPECIAL PURPOSE RUBBER

B. F. Goodrich Chemical Co.—A 20-page booklet gives specifications and application data and shows photos of uses of Hycar American rubber in various forms throughout industry. This special purpose material resists oil and solvents, abrasion, aging and high temperatures.

437 SOLENOID PILOTS

Spence Engineering Co.—A four-page bulletin describes several types of solenoid pilot for use with regulating valves in steam, air, gas and liquid service. Schematic diagrams of typical applications are included.

438 BEARINGS, BUSHINGS

Cleveland Graphite Bronze Co., Div. Clevite Corp.—A 16-page Catalog gives data on engineering, material analyses and applications of bearings, bushings, wear plates, thrust bearings and related products.

439 GUIDED MISSILES

General Electric Co.—Two bulletins cover technical forums conducted by the company's Special Defense Projects Dept. GEZ-1741 covers discussions of systems engineering, aerophysics problems connected with hypersonic flight and hypersonic experimentation. GEZ-1742 includes discussions of the integration of systems test, missile aerophysics and structural frontiers.

440 FIRE PROTECTION

Blaw-Knox Co.—Bulletin 2426 illustrates and describes a new spray sprinkler designed to reduce fire insurance costs by 50 to 90 per cent. Applications, design and layout data on fire fighting systems is included.

441 GROOVING TOOL

Waldes Kohinoor, Inc.—Catalog No. GT2-53 presents general information, engineering specifications, and manufacturing technical data for the Waldes Truarc grooving tool. The manual is illustrated with a number of tool setups and explains the functioning of the tool, particularly its economic performance on recessing operations. It also includes typical applications, dimensions and conversion tables, and ordering specifications.

442 ELECTRIC HEATERS

Edwin L. Wiegand Co.—Catalog D-52 illustrates and describes electric blower-type portable unit heaters, wall and ceiling mounted unit heaters, forced air heaters for large areas, radiant and convection comfort heaters, thermostats and contactors for commercial and industrial use.

443 PIPE FITTINGS

Ladish Co.—A 304-page, tabindexed catalog details specification on complete line of controlled quality butt welding fittings, forged ASA, large diameter and TEMA flanges and forged screwed and socket welding fittings. A 56-page technical data section features latest provisions of applicable piping codes and standards to assist in solving piping problems.

444 STEREOMICROSCOPES

Bausch & Lomb—A catalog discusses principles and equipment used in connection with stereomicroscopy. A guide to the selection of stereomicroscopes and accessories is included, along with reproductions of specimens seen through this medium.

445 FASTENERS

United-Carr Fastener Corp.—Section E of the firm's engineering data catalog covers Dot Teenut fasteners. Photos, specifications and diagrams are included for each series. A revised foreword page lists corrected addresses.

446 FORGING APPLICATIONS

Drop Forging Assn.—"Management Guide to the Use of Forgings," is an informal report planned to stimulate imagination. This six-page booklet states advantages that forgings offer to designers, metallurgists, purchasing agents and executives.

447 STEEL SMOKE STACKS

L. O. Koven & Brother, Inc.—A 4-page bulletin illustrates and describes guyed or self-supporting steel smoke stacks of riveted or welded construction. Sizes and capacities are tabled and formulas for figuring anchor bolts self-supporting and guy wire for guyed stacks are included.

448 CAST IRON SPECIFICATIONS

Gray Iron Founders' Society—A 4-page chart covers commonly used specifications for ductile cast irons, giving properties, chemical composition and typical applications. Included are specifications for cast pressure pipe, soil pipe, valves and fittings. Standards, methods of testing, recommended practice and definitions are also listed.

Nagle® Pumps are good pumps and have many good friends in industry. Typical is Behr-Manning Corp. Division of Norton Co. Abrasives is their business. Four Nagle abrasion-resistant pumps are in service at their plant shown above. The first, installed in 1946 in their boiler house, handles clinker laden water—a severe service.

NAGLE PUMPS are built for abusive applications only—abrasion, corrosion, heat, heavily loaded liquids, trash. Complete range of sizes—horizontal and vertical shaft types. Users re-order again and again on basis of performance. **SEND FOR CATALOG 5206.**

NAGLE PUMPS

NAGLE PUMPS, INC.
1299 CENTER AVE., CHICAGO HEIGHTS, ILL.

PUMPS FOR ABRASIVE AND CORROSIVE APPLICATIONS

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New Catalogs GUIDE

LATEST INDUSTRIAL LITERATURE

449 BELT CARRIERS

Stephens-Adamson Mfg. Co., Standard Products Div.—Bulletin 355 lists carriers for belt conveyors and shows their application in industry. Cross sections and dimension tables are given for the various carriers.

450 STRUCTURAL PANEL

Philip Carey Mfg. Co.—A folder describes a 2-in-1 insulated structural panel for interior use in duct construction, industrial ovens, coil housings, plenum chambers. It is formed of laminated plies of corrugated and flat asbestos paper sheets, bonded with a fire-resistant adhesive.

451 ANALOG, DIGITAL CONVERTER

Norden-Ketay Corp., Instrument & Systems Div.—Four-page bulletin No. 372B has applications, characteristics and installation drawing of ADC-1A analog to digital converter. The unit described has an unambiguous output of 13 binary digits and operates at high speed in clockwise or counter-clockwise operation.

452 FLEXIBLE COUPLINGS

American Flexible Coupling Div., Zurn Industries, Inc.—A 12-page bulletin gives selection and engineering data on a newly-designed line of standard couplings having $\pm 1^1/_2$ deg angular misalignment capacity per gear engagement. Similar data is included on self-lubricating center member couplings.

453 BRONZE, IRON VALVES

Fairbanks Co.—Catalog 51 provides descriptions and specifications on complete lines of bronze and iron body valves. Bronze valves of all types, including solder and brazed end valves with pressure ratings from 125 to 300 lb steam are covered. Iron body valves of all types, including AWWA and Underwriters Approved, with pressure ratings from 125 to 250 lb steam are listed.

454 METER TESTING

Hydraulic Products Co.—Bulletin is illustrated with installation photographs of air-water testing of gas meters ranging from five to sixty light by an air-mechanical lifting and depressing device providing multiple loading.

455 WATER SOFTENERS

Permutit Co.—Bulletin 2386-B describes trouble caused by using hard water. Equipment specifications, operating characteristics, data on ion exchange resins and typical installation photographs are included.

456 MINIATURE COUPLINGS

Thomas Flexible Coupling Co.—Bulletin Mc-100 illustrates and gives specifications of miniature couplings for power transmission. The units are capable of speeds to 50,000 rpm for holding synchronism, relieving bearing loads, holding constant torque and handling parallel and angular misalignment.

457 AUTOMATIC VALVES

A. W. Cash Valve Mfg. Corp.—60-page catalog describes and illustrates line of pressure reducing and regulating valves, relief valves, back pressure valves, vacuum regulators and vacuum breakers, differential pressure regulators, strainers, and diaphragm operated; control valves. Contains 16 new items not previously included in former catalogs.

458 HOT-DIP GALVANIZING

American Hot-Dip Galvanizers Assn.—A 16-page booklet outlines rust prevention in industrial and consumer products through the use of the hot-dip galvanizing process. Included are photographs of products made by the method, and illustrations of production and quality control. Chart compares method with other types of rust prevention.

459 SPRING WASHERS

Associated Spring Corp.—A six-page brochure describes new compact energy "cartridges"—which consist of pre-assembled stacks of multiple Belleville spring washers held together by pins or rivets passing through the washers at or near their neutral axis. Exploded views show how the washers are assembled, and schematic drawings illustrate several typical applications for the cartridges.

460 VERTICAL TURBINE PUMPS

Layne & Bowler, Inc.—A comprehensive book explains vertical turbine pumps. Included in the 72-page hard-bound book are graphic tables, photographs, drawings and charts.

461 VALVES

Ledeen Mfg. Co.—A 16-page bulletin illustrates and describes the company's line of hand, foot, power and solenoid operated valves, air, oil, gas or water powered. Bulletin gives operating and flow cycles, dimensions and weights. Circuit diagrams, parts and accessories are included.

462 PISTON, SEALING RINGS

Koppers Company, Inc., Metal Products Div.—A 24-page brochure illustrates and describes American Hammered piston and sealing rings for various types of industrial applications. Engineering data, tables, and types of material are included. Also available are 4-page folders on conformable oil ring, marine piston rings, chrome-plated piston rings, and piston rings for air and steam forging hammers.

463 LPD STRAINERS

J. A. Zurn Mfg. Div., Zurn Industries, Inc.—Several types of LPD (Low Pressure Drop) Strainers for all purposes and ranging in sizes from $^1/_2$ to 24 in. are described and illustrated in this 16-page Data Manual No. 952. It carries information concerning the factors to be considered in selecting strainers for a specific application, and the effect of flow rate, screen loading, and the viscosity of fluid on pressure drop.

464 TECHNICAL BOOKS FOR ENGINEERS

Ronald Press Co.—Catalog containing detailed descriptions of current technical books on mechanics, engineering, aeronautics, industrial management, metallurgy, applied and physical sciences, etc. Practical reference works like the Ronald Handbooks, basic studies, and pioneering works on the latest engineering and scientific developments are included.

465 STEAM GENERATORS

Union Iron Works—Literature describes line of water tube steam generators from packaged type units for oil and gas fuels or shop assembled coal fired units to field erected water tube steam generators burning all commercial fuels, superheaters, economizers, air heaters, waste heat boilers and other auxiliaries; many illustrations included.

466 NUCLEAR POWER

Alco Products, Inc.—Bulletin details Alco qualifications, as builder of Army Package Power Reactor, as a supplier of nuclear power plants. Twelve-page publication includes progressive transvision of a pressurized water reactor system identical with that in APPR, and covers company's new criticality facility.

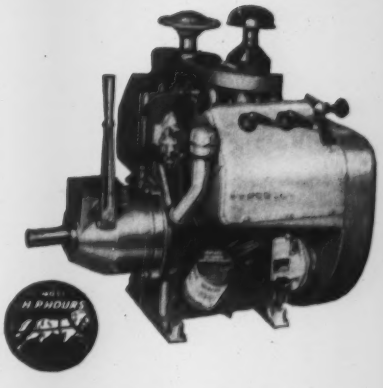
467 ALUMINUM HEAT EXCHANGER TUBES

Aluminum Co. of America—Illustrated catalog contains relevant data on Alcoa aluminum heat exchanger tubes. Covers advantages, fabrication, application in petroleum and petrochemical industries, chemical, steam, atmospheric, air and gas. Also use of aluminum alloys, fluid flow characteristics, heat transfer characteristics, specifications and data with tables.

HYSTER QC 20 Lift Truck

POWERED by NEW VH4 WISCONSIN ENGINE

Hyster Co. specifies the new VH4 30 hp. Wisconsin Engine for the Model QC 20. In the next fork truck you buy, insist on this great new Wisconsin Engine, too. You get foolproof air-cooling, a smooth low-speed "idle" and incomparable horsepower in an engine of this size. Maintenance is simpler . . . no coolant to watch in freezing temperatures. Also, your Wisconsin Engine delivers more torque for more work, and its rugged construction assures longer engine life, more engine stamina. Write for complete data . . . Bulletin S-196.



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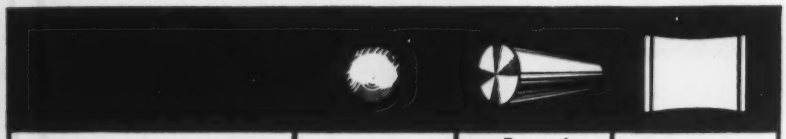
World's Largest Builder of Heavy-Duty Air-Cooled Engines
MILWAUKEE 46, WISCONSIN

for heavy-duty shock load service...

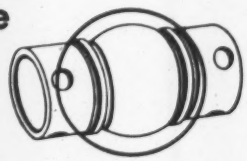
which bearing is best?



	Ball	Tapered Roller	Shafer
Low Friction Loss	✓		✓
Self-Alignment	✓		✓
High Radial Load Capacity		✓	✓
High Thrust Load Capacity		✓	✓
High Shock Load Reserve		✓	✓
Long Life		✓	✓
Fast, Positive Adjustment			✓
Lowest First Cost	✓		
Lowest Over-All Cost			✓

SHAFER Self-Aligning Roller Bearings give you more

Shafer design combines both the low rolling friction of a ball and the high load carrying capacity of a roller. Under shock loads, continuous heavy-duty loads—even under conditions of misalignment—Shafer Bearings maintain full load capacity. You can get off-the-shelf delivery of standard pillow blocks, flange units, flange cartridge units and take-up and frame units. Call your nearby CHAIN Belt District Office Representative or Distributor.



Inner race is segment of a ball.

Roller presents matched curve surface.

and...

"Z" seal keeps dirt out ...grease in

Shafer exclusive—"Z" seal is an all-metal, non-rotating, true self-aligning seal that provides positive sealing under severe conditions.

Micro-lock wear adjustment

Shafer exclusive Micro-Lock provides 12-point adjustment compensating for wear or unusual operating conditions.

Get full information on high bearing capacity. Write for catalog 55A.

CHAIN BELT COMPANY

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LATEST INDUSTRIAL LITERATURE GUIDE

468 PLUG-IN COMPUTING AMPLIFIERS

George A. Philbrick Researches, Inc.—A 32-page booklet describes specific uses of plug-in amplifiers for analog computing. Summing, scaling, integration and differentiation plus combinations of these and other linear and non-linear transformations are shown with definite circuits.

469 SELECTOR VALVE

Republic Mfg. Co.—Catalog No. 356 illustrates and describes a 0-1000 psi pressure balanced selector valve. It is available 2-, 3- or 4-way in sizes from 1/8 to 1 in.

470 CLUTCHES, COUPLINGS

Hilliard Corp.—Catalog MP-5 lists and illustrates a line of industrial clutches and couplings including slip clutch, over-running clutch, single revolution clutch, and automatic centrifugal coupling. Brief description of operation is a guide to suggested applications of each item.

471 HYDRO-MECHANICAL DEVICES

Pathon Mfg. Co.—Bulletin No. 22, 32 pages, illustrates and describes oil hydraulic cylinders and valves. Included are diagrams of dimension tables covering cylinders, connecting eyes, mounting brackets, rams and valves.

472 ATOMIC MATERIALS

Norton Co.—A 16-page instructional booklet covers the use of boron carbide and elemental boron in the atomic energy program. Tables and curves of properties are included in this illustrated booklet.

473 PACKAGED STEAM GENERATORS

Union Iron Works—A 16-page bulletin, MH 3-54, describes Union Type MH packaged water tube steam generators equipped for oil or gas firing or both, with automatic, semi-automatic or manual combustion controls. Included are cutaway illustrations, tube arrangement layouts, photo-sequence story of actual shop assembly and dimension tables for 13 standard sizes from 10,000 to 40,000 lb of steam per hour.

474 MULTIPLIER PHOTOTUBES

Allen B. DuMont Laboratories—Catalog No. 754-MP describes function and design theory of multiplier phototubes. Description and specification of 13 phototubes are included in these 64 pages.

475 MECHANICAL CONSTRUCTION

Dravo Corp., Machinery Div.—"Engineering Constructors," catalog No. 1200, describes the company's mechanical construction services. Prepared as a photographic story, the book shows typical examples of construction projects completed for steel mills, chemical plants, water works and the petroleum industry. Introduction explains how a staff of experienced engineering-construction specialists are equipped to consummate any type of working contract.

476 LARGE D-C MOTORS

General Electric Co.—Large d-c motors, 250 to 8000 hp, are described and illustrated in Bulletin GEA-5643. Applications include metal rolling mills, metal processing lines, mine hoists, paper machines, rubber mills, oil-well drilling rigs, large fans and blowers, line shafts.

477 CHUCKING MACHINES

National Acme Co.—Bulletin CM-51A illustrates and describes 4, 6 and 8 spindle chucking machines in capacities ranging from 5 1/4 to 12 in. Construction features shown in cutaway drawings. Specifications and dimensions are tabled.

478 STEEL REACTORS

American Water Softener Co.—Booklet 500 illustrates and describes the firm's reactor which is utilized for cold precipitation processes associated with water conditioning. Four reactor designs for steel or concrete construction are included.

479 COLD ROLL-FORMING

Yoder Co.—An 88-page booklet tells the story of the equipment for and process of cold roll-forming and uses of its products, their advantages and commercial possibilities. Also listed are auxiliary equipment for curving, coiling, ring-forming, notching, perforating, welding, embossing, automatic cut-off.

480 BELT FEEDER

Omega Machine Co. Div., B-I-F Industries, Inc.—Design features of Model 37-20 belt type gravimetric feeder are covered in Bulletin 35-N62. Unit is designed to feed more than 3000 lb per min.

481 WIRE FORMS

Dudek & Bock Spring Mfg. Co.—Educational brochure gives complete story on the nature and uses of wire forms. Shows how wire forms can do the job of more complicated parts. Brochure translates technical data into understandable language. Also includes valuable informative chart on coil spring manufacturing variations.

482 CONTROL VALVES

Oilgear Co.—Bulletins 80200 and 80300, 24 pages, cover construction, principle of operation and installation dimensions of two-, three- and four-way directional control valves for fluid power systems up to 5000 psi. Eight sizes from 1/2 to 3 in., each with manual, mechanical, hydraulic, electric and electric pilot operators are listed, along with two-way valves with standard normally open or normally closed plungers and over sixty special plungers and three- and four-way valves with seven standard plungers and over one-hundred special plungers. More than 300 special straight, angle or combination pipe tap or welded pipe steel flanges are listed.

483 COPPER TUBING HANGERS

Grinnell Co., Inc.—A 12-page catalog, CTH-56, cover hangers and supports for copper tubing. All hangers are copper plated and accurately sized to fit standard copper tubing. Data is also included on packaged quantities.

484 STRUCTURAL INSULATING PANELS

Philip Carey Mfg. Co.—Form No. 6301 provides data on a rigid, structural material that also insulates for walls, roof decks, partitions. It is made by bonding asbestos-cement board to both sides of a specially processed asphalt-treated insulation board. The material is described as lightweight, water-resistant, approximately 60 per cent light reflectivity, won't rust nor rot and needs no preservative treatment or painting.

485 FURNACE CONSTRUCTION

M. H. Detrick Co.—A 50-page illustrated booklet "Heat Enclosure Methods," outlines the development of furnaces and furnace construction. Suspended arch and wall construction and their application are shown for various types of units. Engineering graphs and tables are presented. Special booklets on incinerators, forge furnaces, open hearths, and industrial insulation are available.

486 RADIATION TESTING

Nuclear Measurements Corp.—Complete monitoring systems for detecting, recording and warning of radioactivity in air, water or gases, is the subject of a six-page folder. The systems are designed for use wherever radioactive materials are handled.

487 MAGNETIC FLOW SWITCHES

Magnetrol, Inc.—Literature describes flow switches in sizes from 3/4 through 2 1/2 in. in standard models are available with bronze bodies, stainless steel bodies, steel bodies, or cast iron, in either threaded or flanged connections. Switching action can be electrical or pneumatic. They use only unfailing permanent magnetic force to actuate switch mechanism.

488 CONDUIT SYSTEM

Stillwater Clay Products Co.—Newest development in underground piping layouts, the "one over one Cert-A-Bar conduit system" is described in a one-page, illustrated information sheet. Advantages of this system in steam and condensate systems, and in high-temperature water systems are listed and explained.

489 BRONZE GLOBE VALVES

Lunkenheimer Co.—A four-page, three-color detailed circular 602-2 on the two pressure classes of LQ600 bronze globe valves, for a variety of services from normal to exceptionally severe, is offered. The two pressure classes—rated at 150 lb SP, 300 lb WOG, and 200 lb SP, 550 F, 400 lb WOG—are described, and all features of each are listed. ASTM, ASME and military specification numbers of alloy for bodies and bonnets are included.

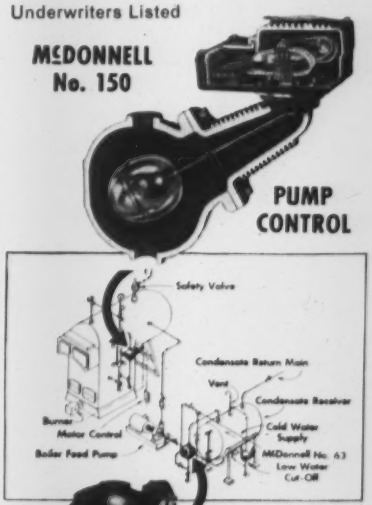
Here's the Great Combination for those...

Medium Pressure Boilers
(up to 150 lbs. psi.)

The No. 150 controls the boiler feed pump the one right way—directly from the boiler water level. Holds boiler level within close limits to assure maximum steaming efficiency and fuel economy. Has extra switch which provides circuits for cutting off burner and sounding alarm in case of low water emergency. It's the most widely-used, time-proved control of its kind.

Underwriters Listed

McDONNELL No. 150 PUMP CONTROL



McDONNELL No. 27T MAKE-UP FEEDER

Adds water to condensate receiving tank whenever necessary to make up for any deficiency in returns. Large feeding capacity meets any sudden boiler demand for water. Needle and seat are stainless steel assuring powerful drip-tight closure. For tank pressures to 35 psi., supply pressures to 100 lbs.

Write for simple installation and wiring diagrams

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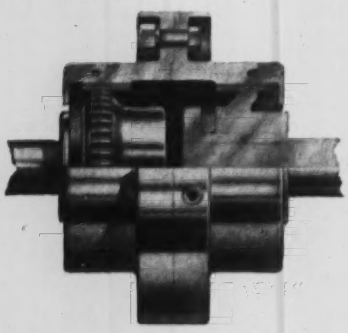
Pioneers Since Ninety Six

McDONNELL
Boiler Water Level Control
and Safety Devices

New FIRSTS are being made with

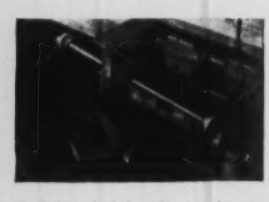
AJAX DIHEDRAL COUPLINGS

Designers and users of modern mills are achieving new high speeds (up to 7200 feet per minute), new high uniformity of gauge, new high quality finish, new high production and maintenance economies. Ajax patented dihedral tooth design is revolutionizing machine design and performance throughout industry. They are made in a wide range of types and sizes,—write for Catalog No. 62.

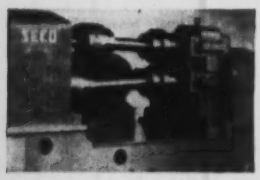


- Handles shaft misalignment... offset and angular... up to a total of 12 degrees.
- All teeth hardened to 50-55 Rockwell C to combine hard wear surface with tough core.
- Available in regular single and double engagement, mill motor, floating shaft and spindle shaft types.

This 37" x 80" 2-high temper pass mill is cutting tonnage costs in the Fairless Works of the U. S. Steel Corp., at Morrisville, Pa.



Ajax Floating Shaft Dihedral Couplings solve angular drive problems on tilting tables for the Green River Steel Corp., at Owensboro, Kentucky.



Two Ajax Dihedral Floating Shaft Couplings driving SECO 48" heavy duty slitter in operation at McLouth Steel Co., Detroit, Michigan, cutting ¼" stainless steel at 100 ft. per min. with 16" diameter knives.

AJAX FLEXIBLE COUPLING CO. INC.
WESTFIELD, N. Y.

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LATEST INDUSTRIAL LITERATURE

490 CONTROL ADAPTERS

F. W. Stewart Corp.—A 16-page catalog describes various adapters for use in conjunction with flexible shafting. These adapters have proven to be most advantageous for control or transfer of action from the source of power to the control unit, the firm states. Adapters pertinent to aviation, automation, electronics, machinery, radio, and other fields are described.

491 MOTOR CONSTRUCTION

General Electric Co.—Bulletin GEA-5980 is a 12-page publication illustrating production testing techniques and motor construction features of 1 to 5 hp dripproof and enclosed motors. The color bulletin also describes servicing and installation advantages of the complete TRI/CLAD 55 line in these ratings.

492 CONDENSED PLUG GUIDE

Cannon Electric Co.—A condensed plug guide describes the lines of various electrical connectors and their uses. The different connector lines or groups are shown with brief descriptions, along with the proper catalog to request for complete information pertaining to each line.

493 FANS, VENTILATORS, BLOWERS

Peerless Electric Co.—Bulletins SDA-160, SDA-200, and SDA-220 describe the firm's line of standard fans and blowers for industrial, commercial and residential use. The bulletins contain engineering data, performance tables, dimensions, ratings and specifications.

494 RECORDING SYSTEMS

Consolidated Electrodynamics Corp.—A 24-page technical bulletin, No. 1561B, covers Data tape recording and playback systems, describes the airborne and ground components, furnishes highly-technical data on the recorder along with operating information and illustrates all integral parts. Also available is a four-page technical bulletin, No. 1576, describing a new magnetic tape recorder reproducer system, showing features, applications, description, and specifications for this ground unit.

495 AIR HYDRAULIC PUMPS

Ledeen Mfg. Co.—An eight-page folder illustrates and describes the company's line of air hydraulic pumps and power units for the operation of high pressure cylinders, clamps, valves, actuators. Application layouts, ratings and dimensions are shown.

496 PURIFIERS, MIST EXTRACTORS, SCRUBBERS, SEPARATORS

V. D. Anderson Co.—Bulletin No. 801 itemizes principal applications of purifiers which remove liquid, solid and dust entrainment from gases and vapors. Contains buying information on internal, receiver and line type separators, mist extractors, and scrubbers. Also describes Anderson's new Quik-Flex thermostatic steam traps as well as Super-Silvertop and Heat-Kwik steam traps and Anderson strainer and float traps.

497 DEAERATION

Cochrane Corp.—Publication No. 4650 explains in capsule form the fundamentals of deaeration and why it is necessary in water conditioning. The principles of operation as well as the advantages and application of the various methods of deaeration are discussed.

498 STEEL SPRINGS

Alco Products, Inc.—A 16-page bulletin covers production of hot and cold-wound steel springs. It describes the company's adaption of automation techniques in spring-making, and contains formulas and specifications for helical extension, volute and Belleville disc springs.

499 AUTOMATIC CONTROLS

Photoswitch Div., Electronics Corp. of America—Bulletin PA 561 illustrates and describes packaged photoelectric systems for industrial control application, including conveyor control, counting, inspecting and sorting, smoke detection and high-temperature measurement and control.

500 DRAFTING MACHINES

Universal Drafting Machine Corp.—An instructor's edition of "Drafting Machine Practice," a technical publication on mechanical drawing is priced at $1.00. The firm also offers a brochure on its Desk-Topper, a drafting machine specially designed for school and college use.

501 CENTRIFUGAL BLOWERS

Roots-Connersville Blower Div., Dresser Industries, Inc.—Bulletin 120-B-14 covers the firm's line of single stage and multistage centrifugal blowers and exhausters. Typical applications include installations in mining, public works, chemical, petroleum, gas, and metal-working industries. Single stage units can be supplied in capacities of 500 to 60,000 cfm, 1 to 8 psig; multistage, 1000 to 100,000 cfm, 8-600 psig.

502 WATER CONDITIONING

American Water Softener Co.—Bulletin 200, eight pages, covers various types of water conditioning processes and equipment. The booklet describes the application, function and operation of the systems.

503 DUST FILTERS

Koppers Company, Inc. Metal Products Div.—A 4-page folder illustrates and describes the compact Model D dust filter. An 8-page brochure covers the Series 12 filter. Both pieces discuss principle of automatic reverse-air jet filter cleaning and give design features and dimensions.

504 STEEL GRATING

Blaw-Knox Co.—A 28-page bulletin illustrates and describes electroforged steel grating and treads for plants, sidewalks, stairs. A table of safe loads is included.

505 AIR DIAPHRAGM CYLINDERS

Westinghouse Air Brake Co.—A four-page catalog illustrates and describes diaphragm air cylinders and diaphragm air chambers with effective areas from 9 to 50 sq in. and strokes from 1¾ to 4 in.

506 GLASSED STEEL

Pfaudler Co.—Bulletin 928 illustrates and describes the corrosion resistance of glassed steel to acid solutions. Resistance charts of various nitric, acetic, sulphuric, hydrochloric and phosphoric acid solutions are included in the booklet.

507 BUILDING DRAINAGE CONTROL

J. A. Zurn Mfg. Div., Zurn Industries, Inc.—Bulletin 56-1 covers systems for wall-type plumbing fixtures, roof drains, floor drains, interceptors, cleanouts, high and low pressure hydrants, swimming pool equipment, pipe line strainers.

508 ELECTRONIC CONTROLS

Dynamatic Div., Eaton Mfg. Co.—Bulletin EC1 covers the construction, performance and maintenance of electronic controls used on the firm's eddy-current adjustable speed drives and other equipment.

509 ALUMINUM BRAZING

Aluminum Co. of America—A 134-page hard cover book presents practical shop data and current developments in the art of brazing aluminum. Detailed descriptions of brazing processes are given along with the answers to most routine questions concerning brazing methods and materials.

Properties of Steam at High Pressures

This is an interim steam table covering a range from 5500 to 10,000 psi and 32 to 1600 degrees F. It is published to provide a reasonable extrapolation of the current tables that will be useful in power systems calculations until an authoritative steam table has been published—five years hence.

1956 $1.00 20% Discount to ASME members

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
29 W. 39th St., New York 18, N. Y.

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LATEST INDUSTRIAL LITERATURE

510 PACKAGED AIR PREHEATERS

Air Preheater Corp.—A 16-page bulletin explains how smaller industrial steam and process plants can save otherwise-wasted Btus of stack gases, and shows how Ljungstrom heat exchangers can raise combustion temperatures, boost output, and cut maintenance. Booklet also describes substantial fuel savings possible with these packaged air preheaters.

511 VIBRATION TEST MACHINES

All American Tool & Mfg. Co.—Bulletin 562 describes seven new models of vibration fatigue test machines equipped with new D type range selector for widely variable acceleration control. The unit is said to provide infinite frequencies from 10 to 60 cps, which are recorded on an electric tachometer. Bulletin also lists typical users; shows installations.

512 GRATING-FLOORING AND TREADS

Irving Subway Grating Co., Inc.—Catalog F-400 contains illustrations, descriptions and engineering data on grating-flooring, treads, and floor armoring (riveted, press-locked, welded types) for industrial and power plants and refinery walkways, stairways, driveways, trucking aisles; ship cat-walks and engine room floors and treads; locomotive, freight and passenger car runways and treads; roadway armoring expansion joints catch basin covers; bridge decking.

513 ISOLATION EFFICIENCY CURVE

Lord Mfg. Co.—Bulletin No. 901 contains a vibration isolation efficiency curve as a guide to the selection of flexible mounting systems for equipment where noise and vibration control is desirable. The curve shows, for simple linear vibration, the percentages of vibration or noise reduction obtainable with mountings of different static deflections where the disturbing frequency of the assembly is known.

514 MULTIPORT VALVE

Hungerford & Terry, Inc.—A 16-page bulletin contains information and photographs of a poppet type multiport valve designed to operate water filters, zeolite water softeners, demineralizing equipment and other water conditioning equipment. The units work manually, semi-automatically or fully automatically.

515 TECHNICAL BOOKS AND PAPERS

The American Society of Mechanical Engineers—A 20-page Catalog describing current books, standards, codes, research reports and periodicals published by the Society and an eight page list of available technical papers.

516 ELECTRIC HOISTS

Detroit Hoist & Machine Co.—Bulletin No. 850 illustrates and describes a new electric hoist, the Detroiter. The unit can also be equipped with an air motor.

517 GAS, OIL BURNERS

National Airoil Burner Co.—Recently revised 20-page catalog, No. 757, describes and illustrates steam atomizing oil burners, mechanical atomizing oil burners, low air pressure oil burners, rotary oil burners, industrial gas burners, combination gas and oil burners, tandem block combustion units, fuel oil pump sets, refractory burner and muffle blocks, valves, strainers, furnace windows.

518 INSULATED PIPING

Ric-Wil, Inc.—A 20-page catalog, No. 57-1, describes prefabricated insulated piping for underground or overhead distribution of steam, oil, hot or chilled water, process liquids; large-diameter prefabricated conduits for housing all utility services; and various related equipment including conduit and pipe testing caps, insulation fittings for 90 deg elbows and unloading slings.

519 STANDARD STORAGE TANKS

Graver Tank & Mfg. Co., Inc.—A 20-page booklet describes the industrial uses of cone-roof tanks. Tables of sizes and capacities are included, and the scope of the firm's fabricating services are indicated.

520 BRONZE VALVES

Ohio Brass Co.—An 88-page bound catalog No. 57, illustrates, describes and gives specifications on globe and angle valves, gate valves, check valves, radiator valves, balancing valves, and special valves made of bronze for industrial and residential use.

521 ROLLER BEARINGS

Hyatt Bearings Div., General Motors Corp.—Catalog 150 illustrates and describes solid roller bearings, wound roller solid race and split race bearings, industrial inch bearings and solid roller bearings in separable inner race, separable outer race and nonseparable types.

522 RETAINING RINGS

Waldes Kohinoor, Inc.—A new 8-page catalog supplements the company's 52-page catalog covering Waldes Truarc retaining rings. The two catalogs include 33 pages of engineering and specification charts, 6 pages of field applications and case histories, 20 pages devoted to Truarc pliers, assembly, and accessory tools, and other relevant information pertaining to the most advantageous use and selection of the rings.

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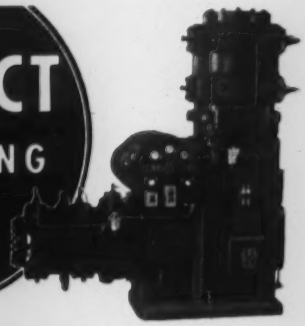

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523 SPRING CLUTCHES

Marquette Div., Curtiss-Wright Corp.—Catalog sheets illustrate four types of Precisionspring clutches: over-running or free wheeling, single revolution indexing type, reversing type, and bi-directional no-back clutches. Exploded perspective drawings and application data for each clutch are included.

524 VACUUM FOR INDUSTRY

Spencer Turbine Co.—Bulletin No. 155, 12 pages, on vacuum for industry contains complete descriptions of stationary and portable vacuum equipment. New features include a table for the rough calculation of the horsepower required for any specific job, and outline of the latest methods of automatic and hand dumping of refuse, a section on the application of vacuum to machine design, and illustrations of the special vacuum tools used in industry.

525 PACKAGE UNIT STEAM GENERATOR

Henry Vogt Machine Co.—Bulletin PSG-2 has line drawings on portable type units from 10,000 to 40,000 lb-hr steam capacities. In standard pressure of 175, 250 and 374 psi.

526 TIMERS

Cramer Controls Corp.—A 4-page bulletin covers Cramer's line of interval timers, reset timers, duplex-cycle timers, time-delay controllers, cycle timers, percentage timers, running-time meters, reversing motor timers, multi-contact timers, and time totalizers. Features of the synchronous motor used are emphasized.

527 REDUCTION EQUIPMENT

American Pulverizer Co.—Literature describes reduction problems of various processing industries. Construction and operating features, specifications are fully discussed and illustrated. Bulletins are available on coal crushers, stone crushers, metal turnings crushers, plastics granulators, wood hogs.

528 WATER AND STEAM VALVES

Golden-Anderson Valve Specialty Co.—Bulletin G-3 describes line of steam and water valves, all with cushioning effect. Types include water pressure reducing valve, altitude control valve, surge relief valve, solenoid-operated liquids valve, swing check valve, hydraulic coke quenching valve, triple-acting and single-acting non-return steam valve, automatic engine stop valve, and steam pressure reducing and unloading valve.

529 DRAWING PENCIL

Venus Pen & Pencil Corp.—A technical test kit with 2 Venus drawing pencils is offered free. Lead is homogenized under the patented colloidal process to assure smoothness, no scratching, no hard spots, no soft spots.

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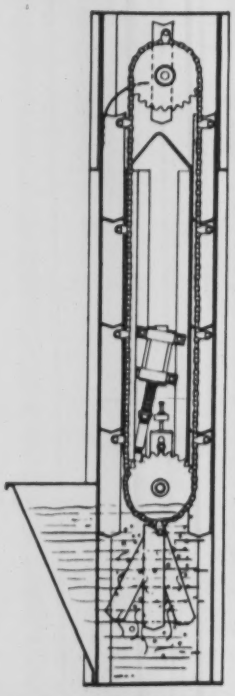

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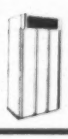

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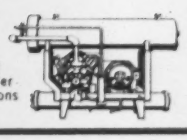

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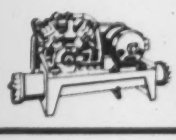

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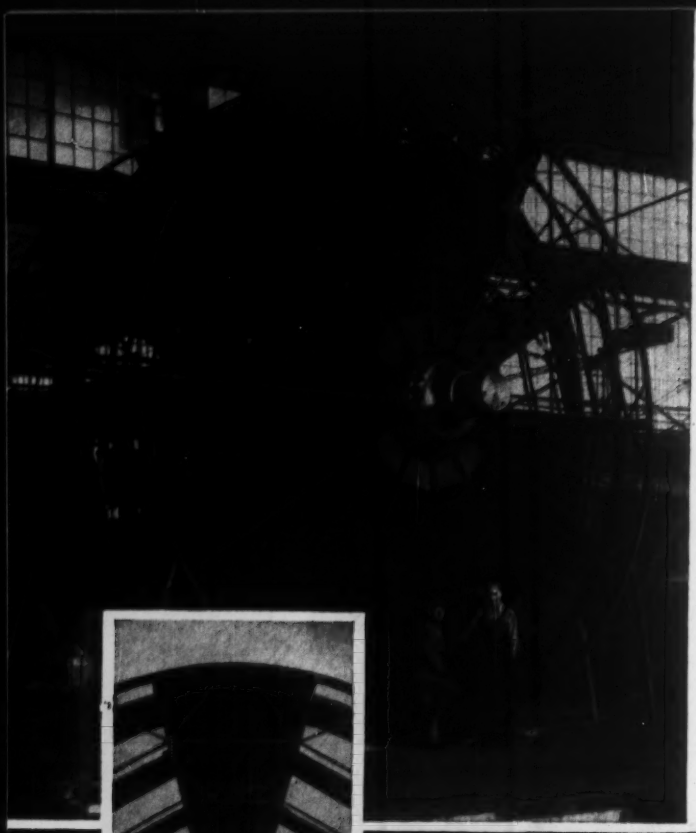
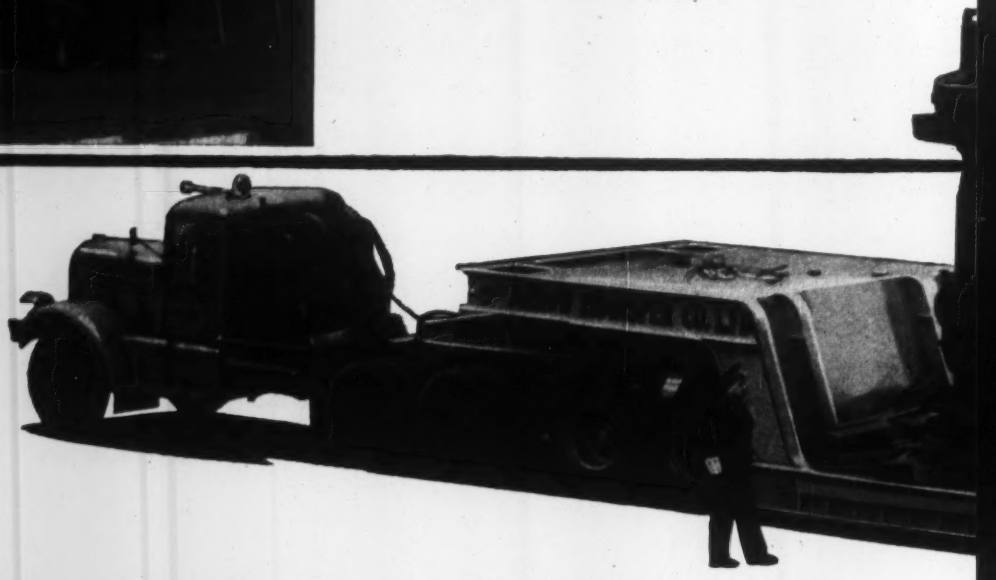


INCREASES CORROSION RESISTANCE. The huge rotor illustrated here is the main structural component of a Ljungstrom Horizontal Air Preheater. Three of these units, designed to serve a 1,900,000 pounds-per-hour-capacity boiler, are among the largest ever manufactured by The Air Preheater Corporation, New York. Each complete preheater weighs 270 tons. The rotor itself—25′2″ in diameter and 10′10½″ deep—when fully loaded with the heating element, weighs about 390,000 lbs.

Because sulfur in the gases combines with moisture—sulfuric acid is formed when the temperature drops below the dew point at the "cold" end of the rotor—corrosive action can be highly severe in this area. Corrosion means maintenance.

Aiming at a reduction in maintenance, the manufacturer cooperated with the U. S. Bureau of Mines in exhaustive tests to determine the corrosion resistance of various materials under sulfuric acid attack in air preheaters. These tests, made over a 5½-year period, showed that the corrosion rate of low-alloy USS COR-TEN Steel was *lower* than all but one of the *high* alloy steels tested, was less than one-half that of carbon steel and less than one-fourth that of cast iron.

As a consequence, USS COR-TEN Steel is specified for the cold end heating elements and containing baskets on all conventional boiler applications. Where unusually severe corrosion is anticipated, USS COR-TEN Steel is also specified in all or part of the rotor including diaphragm plates, bar stock, rim angle and filler plates.



INCREASES DURABILITY, REDUCES COST. Tote boxes have to take quite a beating. Used for handling, storing and shipping automotive and other parts, they must be able to withstand plenty of rough treatment.

That's why the "Hamlintainer" shown here—a *collapsible* tote box that sets up and folds flat in less than 20 seconds—is now built entirely of USS COR-TEN Steel. COR-TEN Steel's greater strength, 50% higher than carbon steel, makes it possible to build the "Hamlintainer" up to 100 lbs. lighter than carbon steel units, yet so strong and rigid that it will withstand long and rugged service and is not susceptible to bending and distortion. The fact that the COR-TEN Steel ends and sides have the stamina needed to permanently maintain their shape is of utmost importance. It means that throughout its long life the box will always be easy to set up, fold and stack flat.

As compared to the metal construction used in an earlier design, USS COR-TEN Steel makes the "Hamlintainer" not only stronger, more rigid and more durable but also less costly to produce, according to the manufacturer, Hamlin Metal Products Co., Akron, Ohio.

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HIGH STRENGTH STEELS
1933 1957
24 YEARS OF PERFORMANCE

High-strength USS COR-TEN Steel pays off in equipment like this

What does your product need to make it better? Greater durability? Bigger capacity? Cheaper maintenance? Lower operating cost?

Do you want to make it stronger, lighter in weight, more corrosion resistant, better able to withstand abrasion, impact and fatigue?

You can obtain any or all of these important money-saving benefits—at little or no increase in cost—by the proper use of high-strength low-alloy USS COR-TEN Steel.

USS COR-TEN Steel is distinguished by its superior resistance to atmospheric corrosion—4 to 6 times that of carbon steel, 2 to 3 times that of copper steel.

In thickness of ½" and under, COR-TEN Steel has a minimum yield point of 50,000 psi and a minimum tensile strength of 70,000 psi. In resistance to abrasion, shock and impact, it is superior to structural carbon steel. Its fatigue resistance is 60% greater.

Thus, when used to directly replace carbon steel, USS COR-TEN Steel will materially increase the strength and durability of vital parts *without* increasing their weight. Or it can be used in thinner sections (1) to reduce weight without sacrificing strength or (2) to increase the capacity of equipment without increasing gross weight or the power required to move it.

You will find our 174-page "Design Manual for High Strength Steels" extremely useful in applying USS COR-TEN or our other High Strength Steels, USS MAN-TEN and USS TRI-TEN "E" to your product. For free copy, simply write on your company letterhead to United States Steel, Room 2801, 525 William Penn Place, Pittsburgh 30, Pa.

INCREASES STRENGTH, SAVES WEIGHT. Shown here hauling a 117-ton transformer, this 150-ton-capacity trailer—built by Columbia Trailer Company, Vancouver, B. C., for the Arrow Transfer Company of that city—is the largest trailer ever built in Canada.

This 80-ft.-long trailer is constructed almost entirely of USS COR-TEN Steel. It is about 25% lighter than if it had been built of structural carbon steel. Specifically designed for handling transformers of giant size, it has a depressed center deck which makes loading and unloading easier and keeps center of gravity low to prevent danger of upset.

Says the manufacturer: "We have found that when a trailer is made from structural carbon steel there is a greater possibility that it can be permanently damaged from overloading than in the case of a similar unit made from high strength steels. That's why, in designing trailers of this type, we always use USS COR-TEN Steel. This construction gives us the high strength needed, plus excellent corrosion resistance and freedom from excess weight—all very important in equipment like this."

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UNITED STATES STEEL

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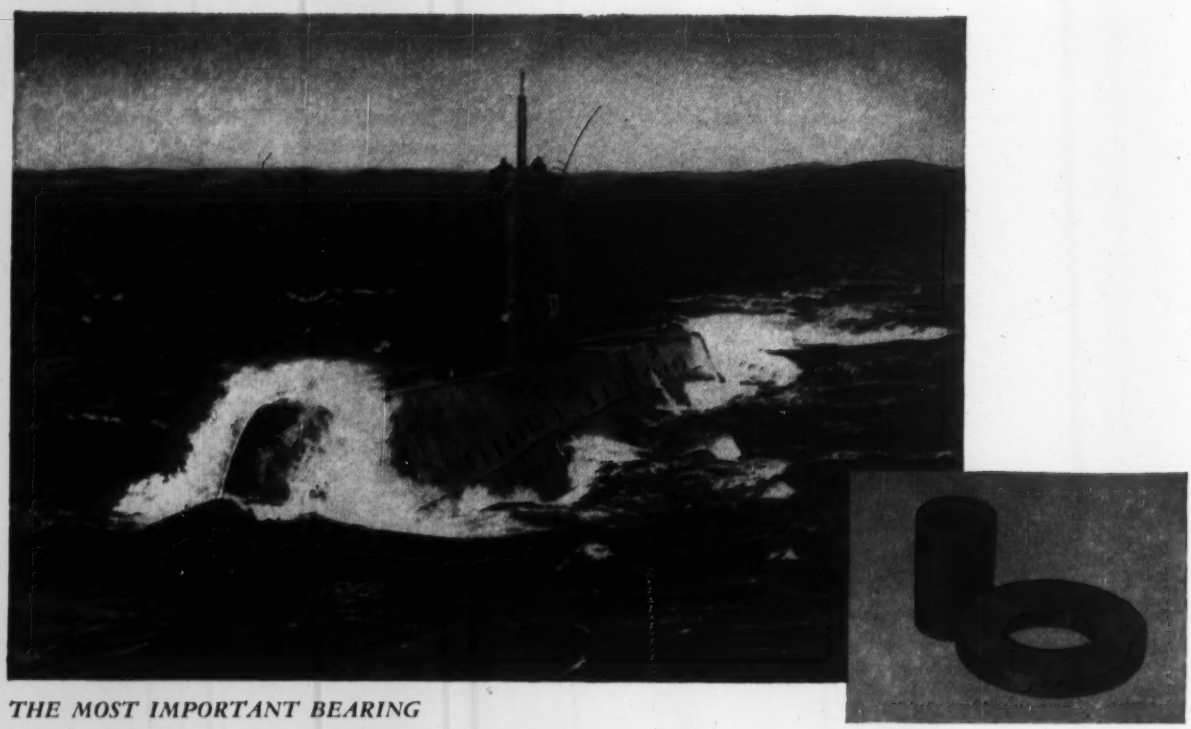

THE MOST IMPORTANT BEARING

Dependability is vital in the power plant of the Navy's atomic submarine U.S.S. Nautilus which has steamed a total of about 50,000 miles of which approximately half has been submerged. In the reactor cooling system of the submarine, special "canned" motor pumps with integrated pump and drive motor were developed by Westinghouse. The bearings in these pumps, which are made of GRAPHITAR, must withstand high speeds, high temperatures, high pressures and must operate for indefinite periods of time without maintenance and with radioactive water as the only lubricant. Westinghouse Electric Corporation engineers—the builders of the Nautilus' atomic power-plant—find that GRAPHITAR is excellent for this difficult bearing application, because of its strength, durability, self-lubricating properties, and chemical inertness. If your design calls for superior bearings, consider the material that worked on such a demanding job.

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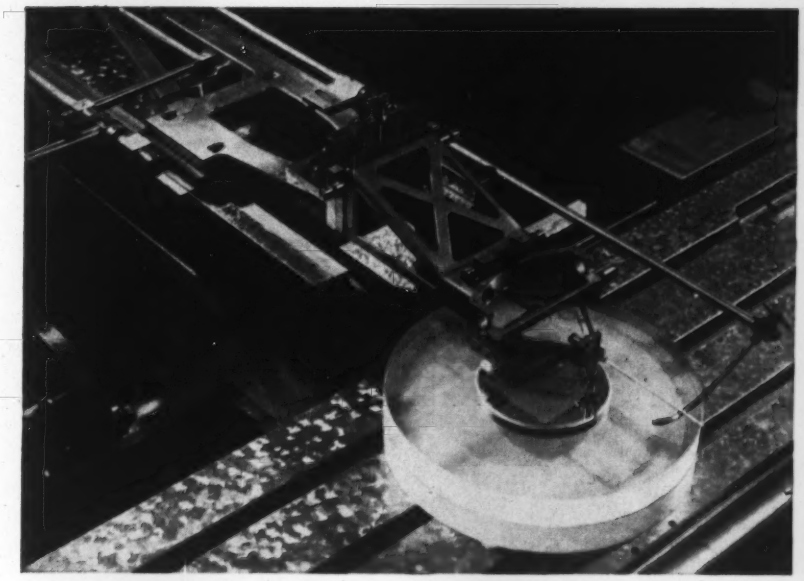
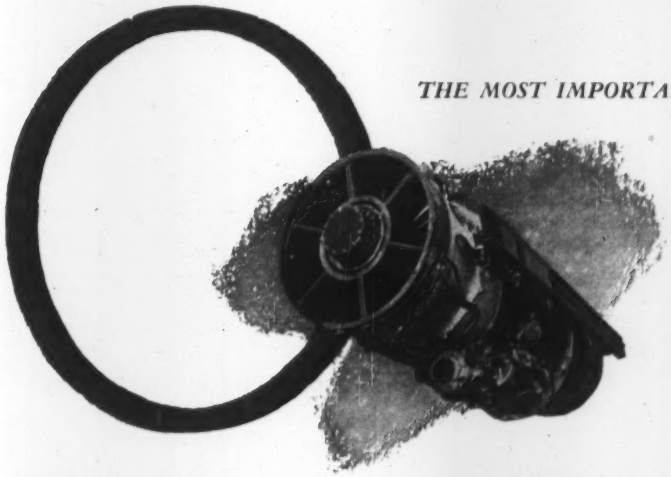


THE MOST EXACTING BEARING

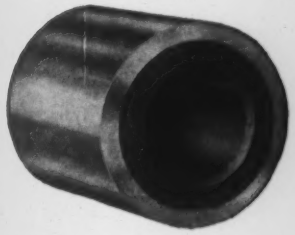
The Bausch & Lomb Optical Co. of Rochester, N.Y., world renowned manufacturer of precision, scientific optical instruments, employs 10 GRAPHITAR bearings in its unique and highly specialized "ruling engine." The GRAPHITAR bearings provide dimensional stability within one-millionth of an inch for micro-inch accuracy in cutting 15,000-30,000 equidistant lines to the inch on 7" aluminized glass blanks to make diffraction gratings used by science and industry for spectroscopic analysis. Bausch & Lomb engineers have found that GRAPHITAR is unsurpassed as a bearing material where very close tolerances must be maintained and where frequent starting and stopping under heavy loads is a problem. These bearings have contributed greatly to the achievement of extreme accuracy in this application. If you require precision performance as was the case with a "ruling engine" why not use GRAPHITAR?

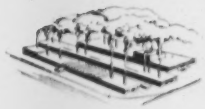
THE MOST IMPORTANT SEAL



GRAPHITAR is the main shaft seal in the Pratt & Whitney J57 turbojet engine which powers many of our new aircraft, including the huge Boeing B-52 Intercontinental Bomber, which has eight of these turbojets. Naturally, the J57 must perform with utter dependability. One of the components of the J57 is the air/oil seal of GRAPHITAR on the turbine main shaft, and this seal is subjected to tremendous shaft speeds, as well as other taxing physical conditions. GRAPHITAR parts can stand severe operation because they are strong and are virtually unaffected by extremes of speed, pressure, and temperature. If your product develops high speeds or other difficult physical stresses on its parts, perhaps GRAPHITAR components could give it more dependable operation.

THE TOUGHEST APPLICATION





Steel mills are famous for the rough, tough, heavy-duty jobs that they perform. In such difficult steel mill applications as bearings for shear and cut-off tables or coil and slab conveyors, metal-backed GRAPHITAR parts provide exceptional strength and durability. GRAPHITAR alone is a very strong bearing material, and when backed with metal has added resistance to shock. Because of its very low coefficient of friction, GRAPHITAR can operate under heavy loads at high speeds with no lubrication. Can the strength and superb bearing qualities of GRAPHITAR simplify your product design?

Get your copy of Engineering Bulletin No. 20.

GRAPHITAR is compacted from carbon-graphite powders under great pressures, then furnaced at heats near 4500°F. It can be formed in relatively complex shapes and ground to tolerances as close as .0005". For more information on this strong, light, self-lubricating engineering material, write for our Engineering Bulletin No. 20.

218

GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION, SAGINAW 4, MICHIGAN

ENGINEERING BULLETIN

ON MICRO-BEARINGS

Miniature Instrument Ball Bearings

NEW HAMPSHIRE BALL BEARINGS, INC.

PETERBOROUGH 1, NEW HAMPSHIRE

***Subject:* BEARING FITS AND FITTING PRACTICES**

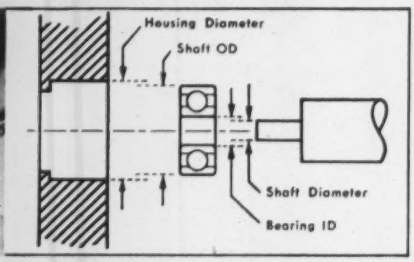


FIG. 1 Principle factors involved in fitting Micro-Bearings. Handling and fitting tools such as furnished by the Baker Co., Maplewood, Maine, enable operators to place or remove Micro-Bearings quickly, easily and help avoid damage.

As shown in *Fig. 1*, the fitting of Micro-Bearings, like the fitting of larger ball bearings, chiefly involves the clearances between the inside diameter of the housing and the outside diameter of the bearing; the bore of the bearing and the diameter of the shaft. Obviously, proper handling and fitting is an important factor in assembling the bearing to both shaft and housing.

Arriving at workable clearances is the subject of this bulletin.

RECOMMENDED FIT

In view of the absence of standards for shaft and housing fits in assembling instrument bearings, this data sheet is based on experience of users who are heavily involved in fitting problems. For example, the use of interference fitting *tighter than line to line* is not recommended for the majority of applications.

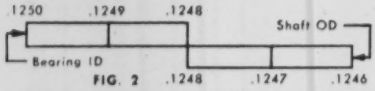


FIG. 2

The achievement of the desired fit by dimensioning is illustrated in *Fig. 2*. The bearing ID is represented by the top blocks and the shaft OD is represented by the lower blocks. Such a block diagram could also be applied to housings and bearing outside diameters. In this block diagram, it will be noted, the bearing ID is represented by a 0.0002" tolerance with a similar tolerance for the shaft. A resulting fit of line to line to .0004" loose is shown.

An interference fit *not* tighter than line to line is suggested for the following reasons:

1. *Difficulty in assembly.*
2. *Difficulty in disassembly. This is often more hazardous than the assembly operation and may result in total bearing destruction.*
3. *Reduction in radial play.*
4. *Danger of bearing ring conforming to possible poor geometry of mating shaft or housing.*

TOLERANCE DISTRIBUTION

The maximum 0.0004" loose condition shown in *Fig. 1* may be excessive in some applications. The fitting problem then resolves itself to reducing this extreme, and yet maintain the *maximum* tight fit of line to line. The looseness may be reduced by redimensioning the shaft to 0.1249/0.1247 as

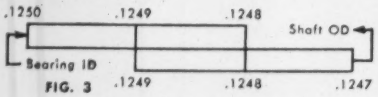


FIG. 3

shown in the block diagram, *Fig. 3*. If the frequency distributions of shaft and bearing ID sizes were statistically normal, the modal fit of all parts would be 0.0001 loose. Accordingly, an insignificant percentage of parts would be mated to the extreme values, and for practical purposes could be ignored.

With regard to bearings' outside diameters and bores, however, normality of the distribution curve *cannot* be assumed. During the grinding operation, the "most metal tendency" tends to skew the frequency distributions for bearing ID's and OD's in the direction of most metal.

In grinding and finishing shafts and housings, similarly skewed distributions occur.

Operating on a modified probability distribution of tolerance is possible if the volume of parts is sizeable. But the approximate distribution of shaft and housing sizes *must* be verified if this method is to be used.

MATERIALS and SURFACE FINISHES

The ease of assembly is also affected by materials and finishes. The following factors must be considered:

1. *The galling characteristics, hardness and ductility of the materials involved.*
2. *Finish lay patterns produced by various tools and techniques used.*
3. *RMS surface finish values achieved.*
4. *Geometry of shafts and housings as regards out-of-roundness, taper, etc.*

The possible combinations of these elements in any single application are so numerous that their gross effect can only be ascertained by trial and error, or by a detailed study of operations on individual applications.

SIZING METHODS

Close tolerance fitting may be achieved by performing supplementary sizing operations on housings or shafts by the following methods:

"Bearingizing Tools" manufactured by the Cogsdill Tool Products, Inc., have been used on both housings and shafts, and potentially yield the greatest accuracy in the shortest period of time *(Fig. 4)*. A — Shaft sizing tool operates by peening oversize shafts to proper diameter. B — Internal Bearingizer enlarges housing holes to proper diameter.

"Ball sizing" has been used with a fair degree of success on through holes. This is essentially a swaging operation utilizing hardened steel or carbide balls.

While shafts may be polished by hand this is an expensive operation and may jeopardize good shaft geometry.

FIG. 4

CODING

Segregation of all parts into .0001 increments has been advanced by some bearing users as a solution to fitting problems. Upon request and for an additional cost, NHBB will code a given shipment to the following table.

DESCRIPTION	CODE	BORE TOLERANCE	O.D TOLERANCE
LARGE BORE LARGE O.D.	11	+ .0000" − .0001"	+ .0000" − .0001"
LARGE BORE SMALL O.D.	12	+ .0000" − .0001"	− .0001" − .0002"
SMALL BORE LARGE O.D.	21	− .0001" − .0002"	+ .0000" − .0001"
SMALL BORE SMALL O.D.	22	− .0001" − .0002"	− .0001" − .0002"

Coding is not a general solution to the problem of fitting. Experience has shown that unless assembly techniques can cope with the existing distribution of bores and OD's within their .0002 spread, an unbalanced stock situation results in the user's plant.

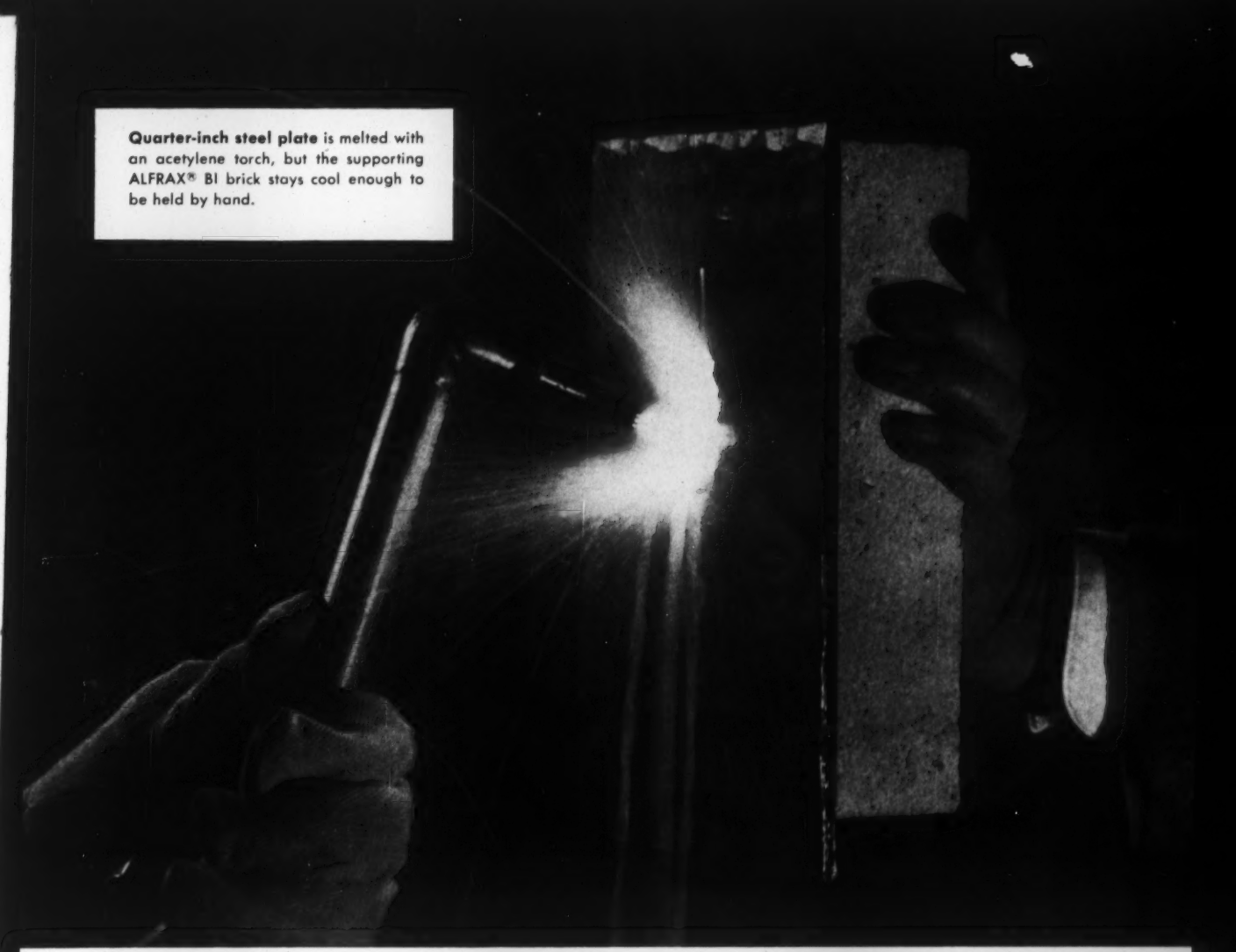
Manufacturing to closer boundary dimension tolerances is not recommended at the present state of the art. It is not usually feasible to mass produce bearings to a .0001 tolerance spread. It is generally necessary to produce some two to four times the quantity of parts desired to fulfill such requirements on the basis of selection from a standard .0002 tolerance. When a user of bearings relies solely on coding of parts, a procurement and stocking problem is eventually created.

Close collaboration between the bearing manufacturer and user is necessary in planning to meet fitting problems since neither one alone has access to complete knowledge or control over all the variables involved.

DESIGNERS HANDBOOK *OFFERED FREE* TO ENGINEERS

If you work with miniature bearings, you'll find this new, 70 page authoritative publication a great help in solving problems in designing instruments or small electro-mechanical assemblies.

It will be sent free to engineers, draftsmen and purchasing agents. **Write to: New Hampshire Ball Bearings Inc., Peterborough 1, N. H.**



Quarter-inch steel plate is melted with an acetylene torch, but the supporting ALFRAX® BI brick stays cool enough to be held by hand.

Refractories...for really high temperature insulation

The problem of heat insulation at extreme temperatures is solved by two of Carborundum's refractories:

One is made of fused alumina "bubbles" or hollow spheres, bonded and high fired. These selected bubbles give proper balance between the number of surface temperature drops and total pore space (about 65% porosity) to effectively decrease heat flow between hot and cold faces. The alumina imparts high hot strength to the finished refractory, trade-marked ALFRAX BI. Under a load of 12½ psi and a temperature of 2732° F held for 1¾ hrs., less than 1% contraction occurred. No contraction whatever developed in 5 hour reheat tests at 3092° F. This combination of properties makes ALFRAX BI refractories unique in their ability to insulate at temperatures where other materials are impractical.

The other is FIBERFRAX® ceramic fiber, produced by blowing an alumina-silica fusion. Among its properties are high insulating values, light weight, resiliency, and corrosion resistance. All are retained at 2300° F. In some cases, this fiber can be used successfully up to 3000° F. It is supplied in long and short staple, rope, board, paper, block, blanket, etc.

These products are but two of the many super refractories pioneered by Carborundum. Among them you are almost certain to find answers to your refractory and high-temperature problems. For help, fill in and mail this coupon today.

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The Carborundum Company, Perth Amboy, N. J., Dept. I 47

Please send me:

- ☐ Forthcoming issue of Refractories Magazine
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VU Boilers exceed performance guarantees

at Central Fibre Products Co.

The two C-E Vertical Unit Boilers installed in this plant have exceeded their guaranteed efficiency of 82.6% and guaranteed peak capacity of 100,000 lb steam per hr. These stoker-fired units are equipped with a C-E overfire air system that *works to perfection* by completely burning out all combustibles at the proper point, allowing for a *very clean furnace.* There is *absolutely no smoke* from the stacks. Furthermore, the draft loss of each unit – as well as the flue gas temperature leaving the economizer – is lower than the customer expected.

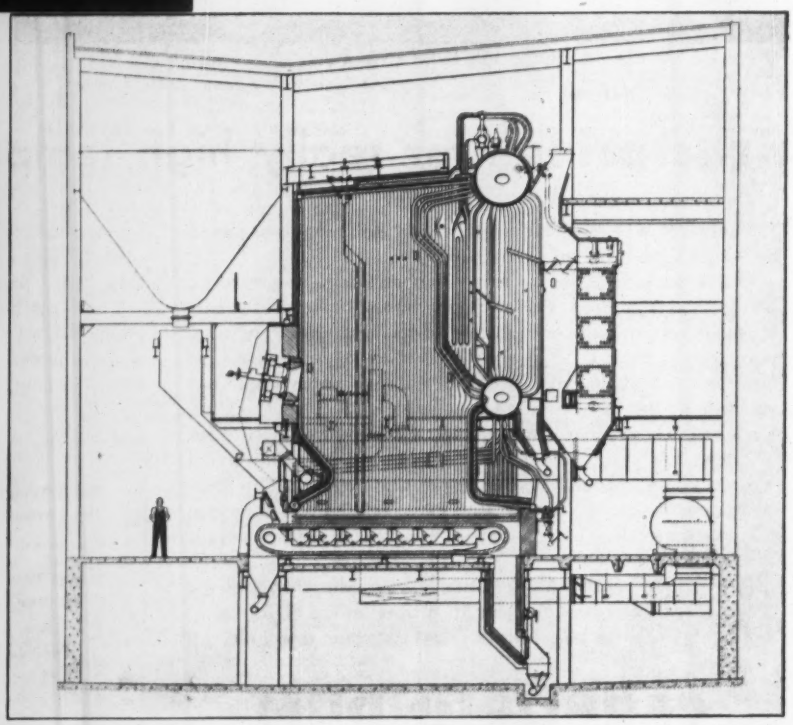
The above comments are all contained in a report written by the H. M. Wilson Company, Inc., Consulting Engineers to the Central Fibre Products Company, of Quincy, Illinois. Of course, it won't hurt to get the opinion of the customer, too, if you're interested. They will be very happy to discuss their boiler installation with you.

Incidentally, when you need boilers, consider the fact that Combustion has a complete line of steam generating and fuel burning equipment suitable for any pressure, temperature and fuel requirement.

Below: Cross-sectional elevation of the C-E Vertical Unit Boiler, Type VU-50X, installed in the Mill Division Plant of the Central Fibre Products Company, Quincy, Illinois. There are two units, each fired with a C-E Traveling Grate Stoker and designed for the future use of oil or gas as alternate fuels.

Present operating conditions are 185 psi and 450 F. Each unit has a maximum continuous capacity of 85,000 lb per hr and a four hour peak of 100,000 lb per hr. The boilers are designed for 650 psig and in the future will operate at 610 psig and 650 F.

Firing aisle at the Central Fibre Products Mill Division plant at Quincy, Ill. This is a front end view of two C-E Traveling Grate Stokers which fire the VU Boilers as shown by the cross-sectional elevation drawing.



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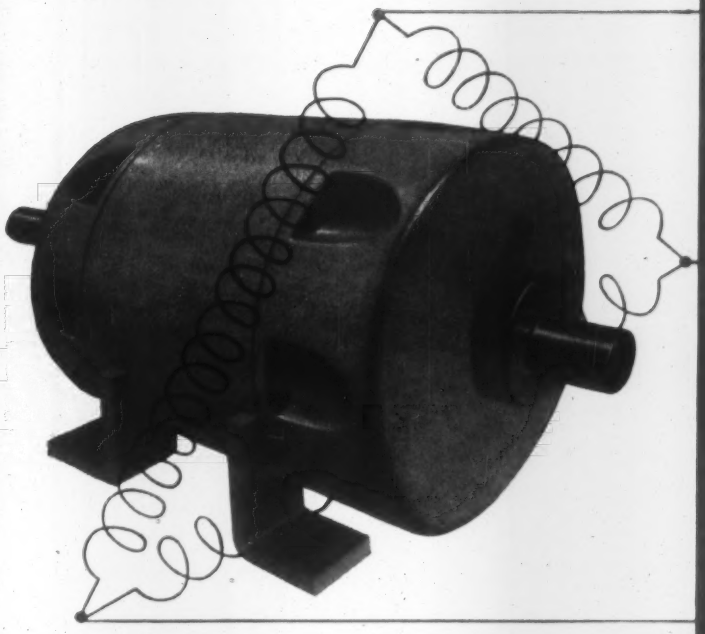


SIMPLE DEPENDABLE protection against phase failure and phase reversal

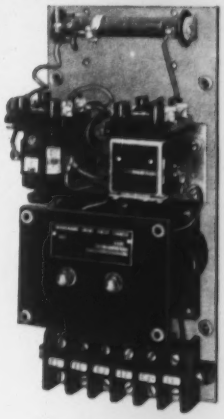
A-B protector opens control circuit in 3 to 4 cycles...under all load conditions

When men, motors, or the driven machines can be "hurt" by "phase failure" or "phase reversal" . . . the new Allen-Bradley Bulletin 812 should be used as a low cost and reliable "safety" insurance. It detects phase failures and reversals electrically, and within not more than 3 or 4 cycles, opens the motor control circuit—regardless of motor load (including no load)—and thus stops the motor.

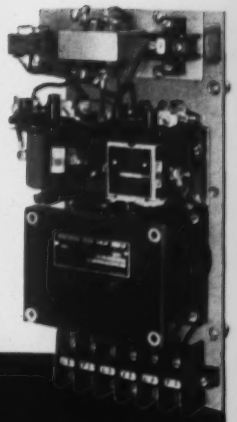
The Bulletin 812 Type A relay protects motors against all phase failures. The Type B relay protects motors against loss of a phase and reversed phase rotation. For the first time, dependable protection is provided for motors supplied by Wye-Delta and Delta-Wye power systems having the neutral ungrounded or not connected to the circuit.

Bulletin 812 relays offer positive protection against motor or machine damage due to opening a primary line—and under all "load" conditions. No field adjustment is required. Remote reset is inherent. Furthermore, as a static device which does not rely for its operation on "motor" revolution the possibility of failure to operate is eliminated.

Bulletin 812 relays are built in four sizes which will reliably protect motors with full load currents from 1.25 amperes to 300 amperes. Let us send you more information about this dependable answer to phase failure and phase reversal problems.



Bulletin 812 Type A phase failure relay protects a 3-phase motor against loss of a phase.



Bulletin 812 Type B phase failure and phase reversal relay protects a 3-phase motor against both loss of a phase and phase reversal.

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QUALITY
MOTOR CONTROL

A-B Quality

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In Canada—
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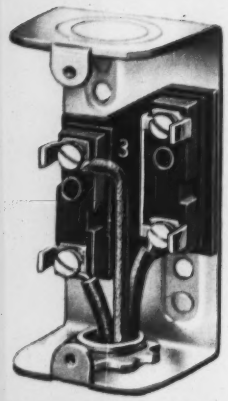
Galt, Ontario

4-57-MR

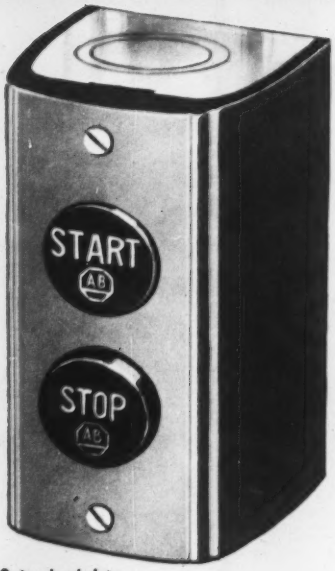
new Allen-Bradley Bulletin 800 Standard-duty Push Buttons

CAN BE WIRED IN HALF THE TIME!

CONTACT MECHANISM IN THE COVER—COMPLETELY PROTECTED FROM CARELESS SCREWDRIVERS AND CARELESS WIRING.



WIRING TERMINALS IN THE BASE —COMPLETELY EXPOSED FOR EASY WIRING.

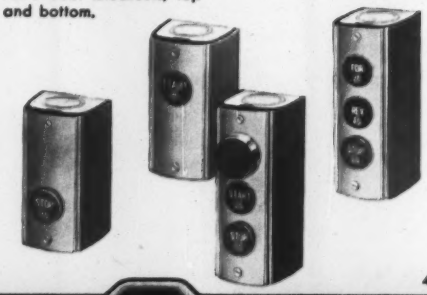


Here's an entirely new idea in push button stations—a wrap-around cover which contains and protects the contact mechanism. Removing the cover exposes all terminals for instant and easy wiring. Heavy, silver plated contacts connect the push button assembly in the cover with the terminals in the base.

Matching ribs in the cover and notches in the molded terminal base eliminate the possibility of having wiring connections made incorrectly. A molded, bakelite shield protects the contact mechanism and prevents careless wiring from interfering with contact operation. All push button contacts are silver and of the double break construction.

Specify the new Allen-Bradley standard-duty station on your next order. Its installation time-saving feature, alone, should make you a regular customer!

Bulletin 800 standard-duty push buttons—with strong, gray, molded cover are "good looking" and "safe" in operation. All stations have dual knockouts, top and bottom.



4-57-MR

SELECTOR SWITCH

You can't beat this for convenience—a selector switch with the same easy-to-wire construction as the push buttons, shown above—plus the feature that you can change—*in seconds*—from two position to three position (or vice versa)! The correct name plate is furnished with each switch. See for yourself how easily this is accomplished.

CHANGE IT FROM 2 POSITION TO 3 POSITION (or vice versa)...in 30 Seconds!

A-B Quality

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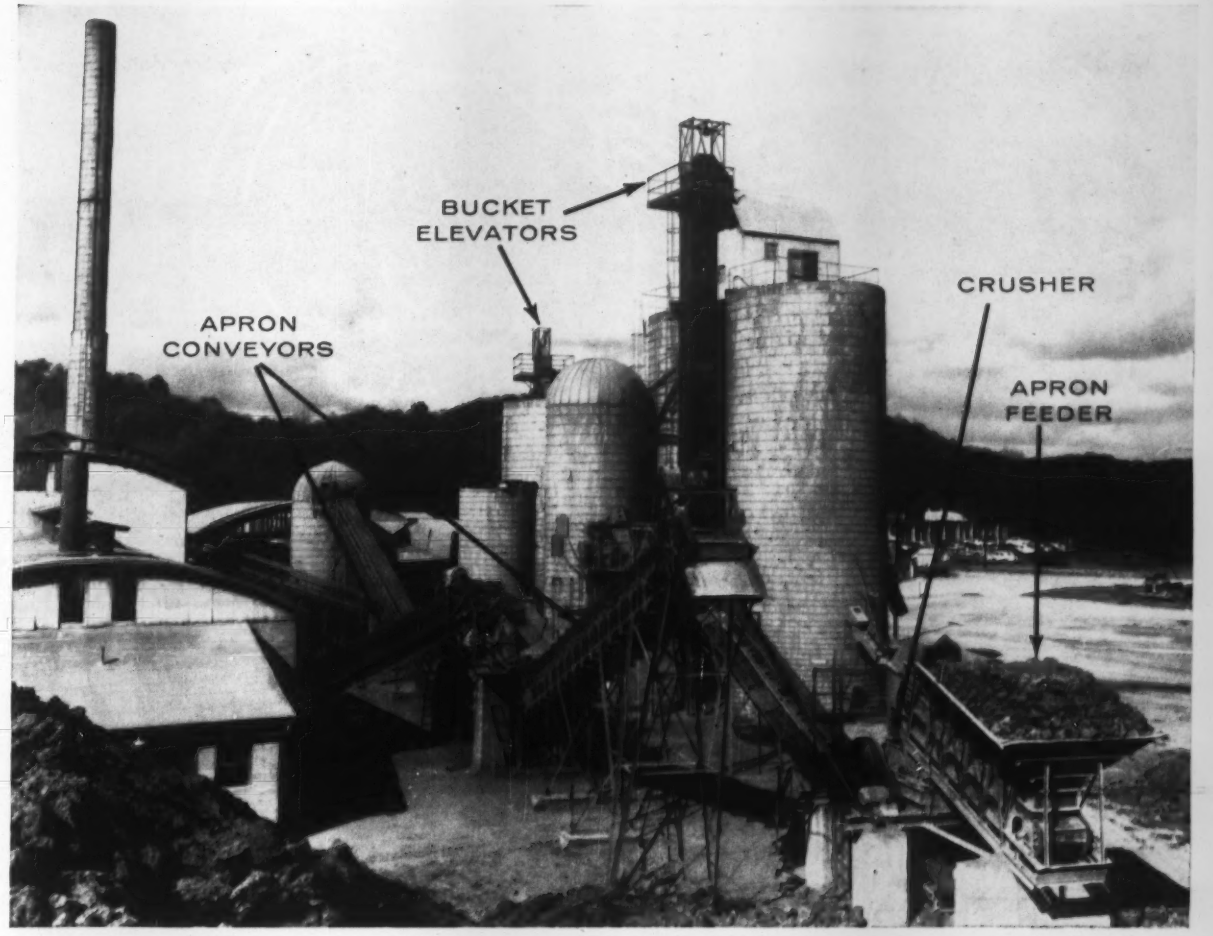

Still other Jeffrey equipment, not visible here, is contributing to the high efficiency of this concrete products plant.

Flexible standard units are engineered by **JEFFREY** to meet your special requirements

Whether you're modernizing an existing system or planning an entirely new plant layout, let Jeffrey engineers assist you. They'll recommend the combination of conveying and processing equipment giving you highest production at lowest possible cost. Jeffrey's long line of standard units permits almost endless combinations to meet special requirements.

For this help, and for catalogs containing complete information on Jeffrey equipment, write to The Jeffrey Manufacturing Company, Columbus 16, Ohio. Replacement parts available from Jeffrey authorized distributor stocks.

In addition to the units named, the following Jeffrey equipment is widely used in the aggregate, stone, sand and gravel, clay, phosphate and sulphur rock industries:

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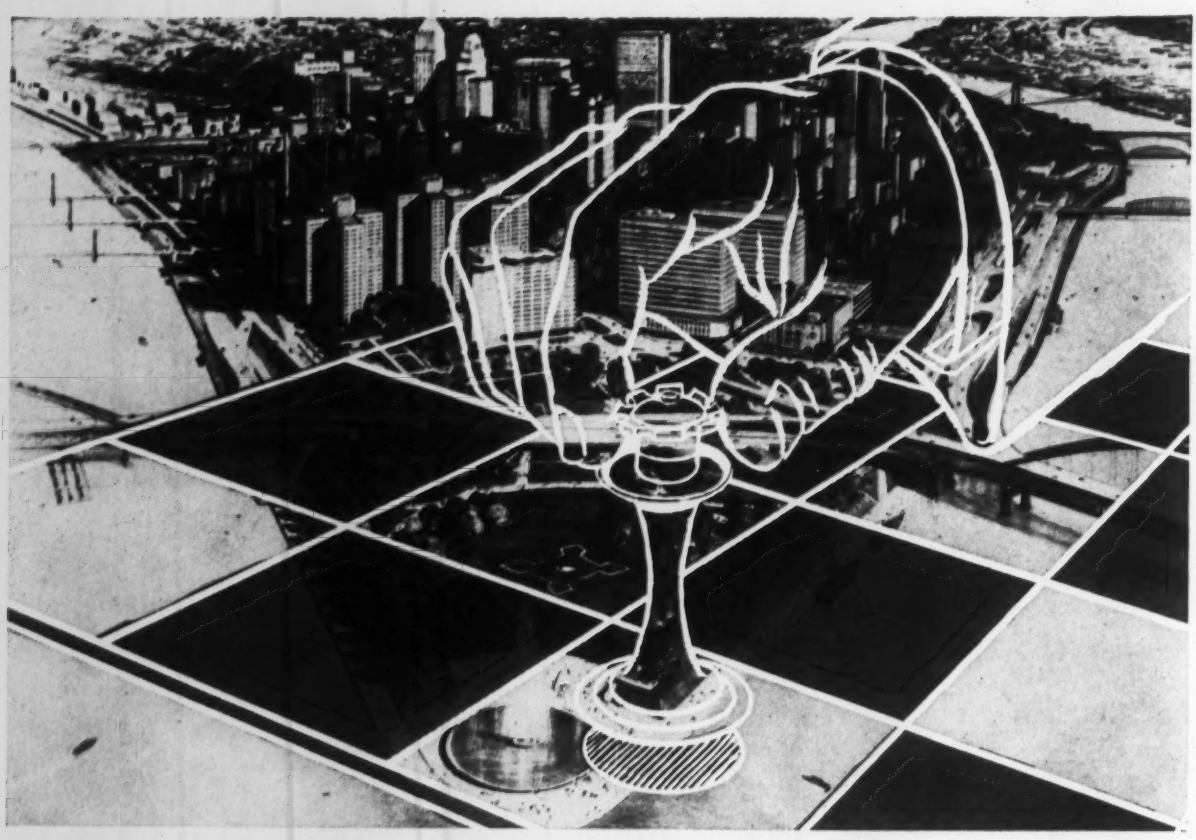

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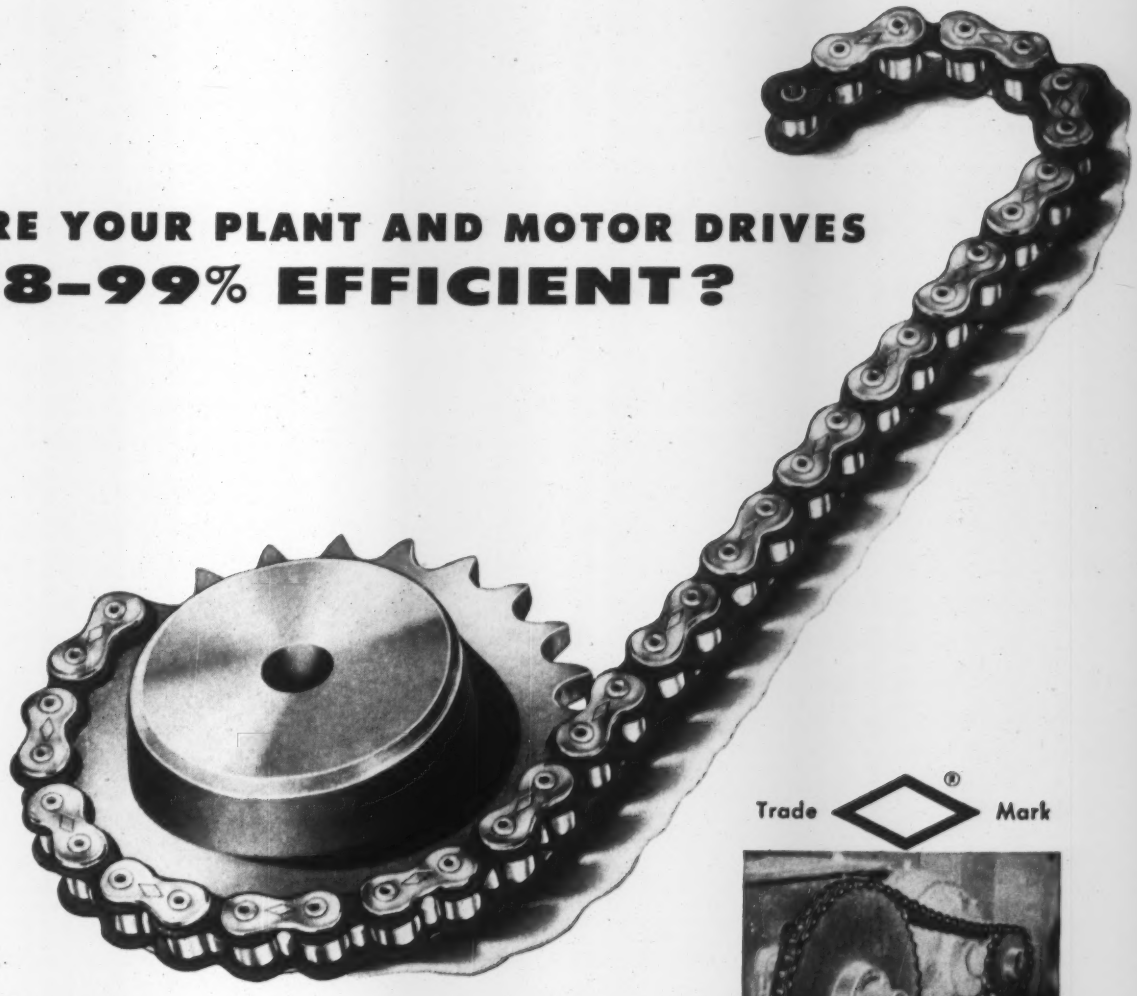

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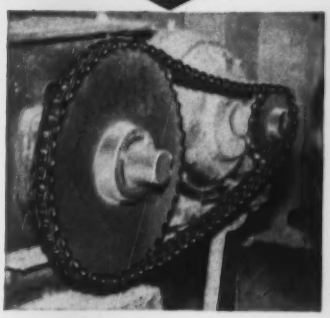

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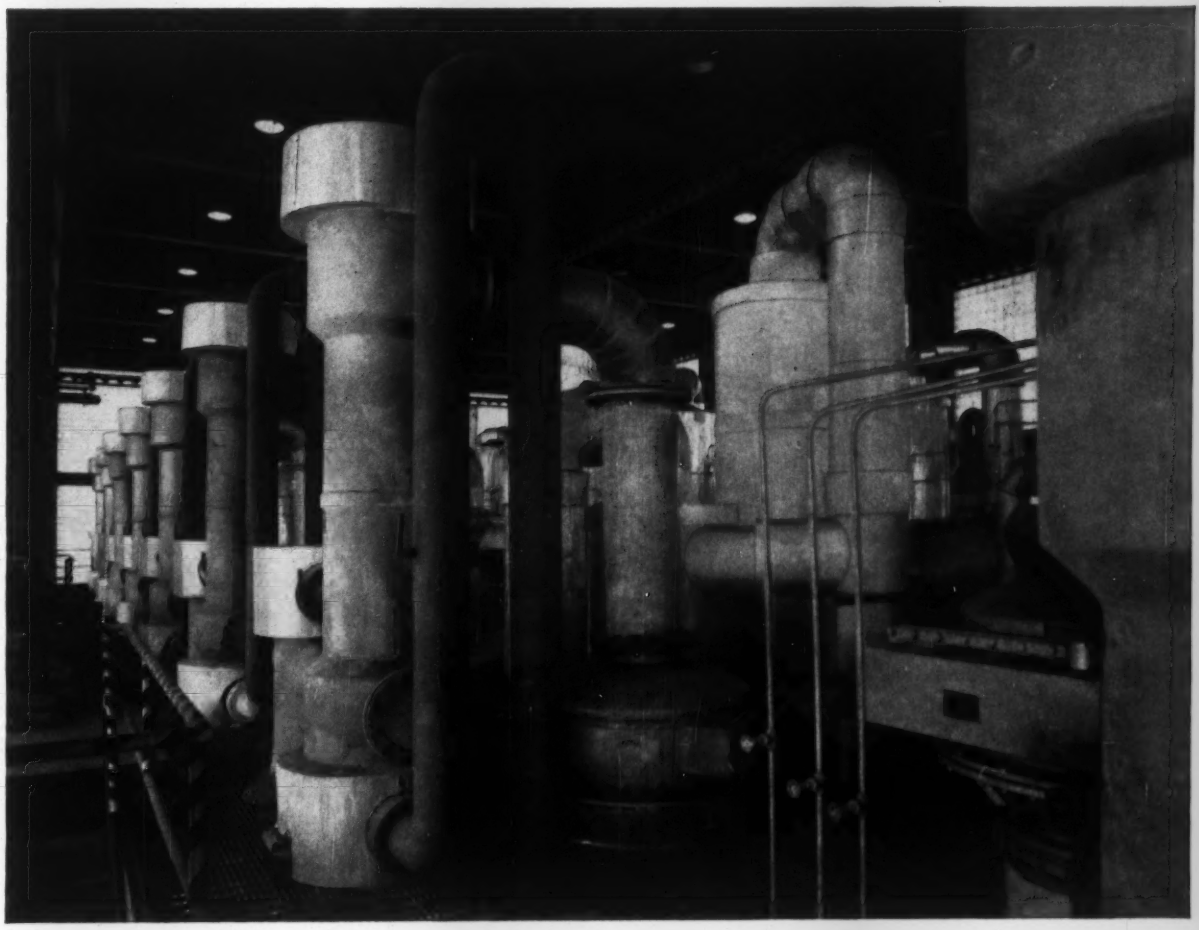

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Rarely does a heat exchanger manufacturer have the privilege of equipping a plant so completely as Alberger has had at the Tonawanda plant of BECCO Chemical Division, Food Machinery & Chemical Corp., a leading producer of hydrogen peroxide and related products. Floor upon floor, building after building of the modern BECCO plant is filled with Alberger Heat Exchangers — millions of dollars worth, every penny of it a testimonial to Alberger's dependability.

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look at the EXTRA STRENGTH *in these gears*

Notice how the teeth are continuous across the face of each gear in the photo? That is a characteristic of Farrel herringbone gears, which, instead of a useless center groove, have a *backbone* where the helices meet. This puts the entire face width of the gear to work for you. It pays off in *extra strength* and greater load and shock capacity — in smaller space.

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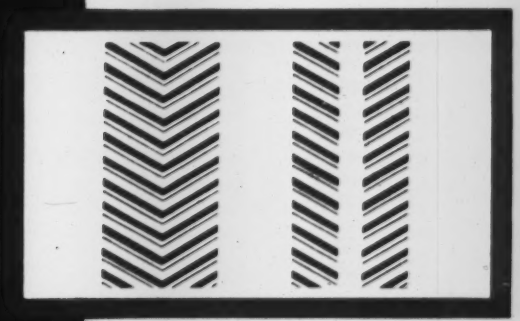

This comparison shows the greater tooth area of the Farrel continuous tooth herringbone gear (left) which gives it greater strength than the double helical gear with center groove (right).

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TO THE MEMBERS OF———

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Members of the ASME are invited to name any number of engineers as candidates for membership. Engineering acquaintances should be qualified by both fundamental training and experience for one of the technical grades. Those who do not have an engineering degree may show the equivalent thereof through actual practice. Executives of attainment in science or industry may associate with the Society as Affiliates.

THE American Society of Mechanical Engineers promotes Mechanical Engineering and the allied arts and sciences, encourages original research, fosters engineering education, advances the standards of engineering, promotes the intercourse of engineers among themselves and with allied technologists; separately and in cooperation with other engineering and technical societies, and works to broaden the usefulness of the engineering profession.

As a post graduate school of engineering, the Society brings engineers into contact with each other, with leaders of thought and with new developments; it fosters the interchange of ideas, develops professional fellowships, and encourages a high standard of professional conduct—all with the purpose of advancing civilization and increasing the well-being of mankind.

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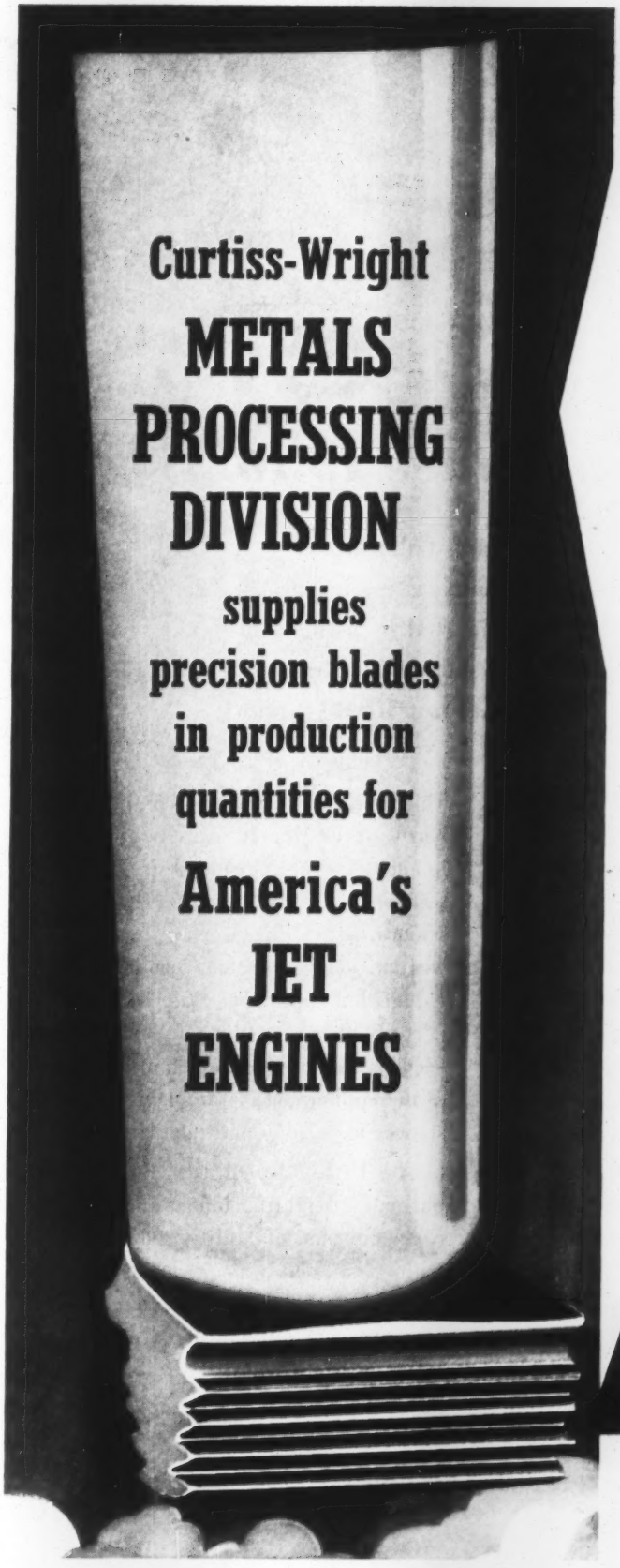

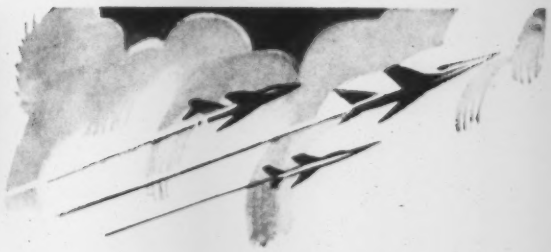

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These accomplishments have, of course, stemmed from an outstanding group of men working with unmatched laboratory facilities. But just as important — and the key, perhaps, to UCRL's successes — has been the spirit with which these men work.

For UCRL is managed and directed by scientists and engineers — men who are liberal with their own knowledge and enthusiastic in the encouragement of their teammates' new ideas and new techniques.

This is the constant and continuing spirit of UCRL. It is to be found in each new and expanded project — whether it involves pure or applied science. It keynotes work on nuclear weapon design, nuclear propulsion, controlled thermonuclear energy (Project Sherwood), and high current accelerators, as well as such problems as the application of radioactive substances to biology and medicine.

The UCRL "spirit" appeals to a particular kind of scientist and engineer — to men of ability and imagination, to men who wish to move forward and challenge the unknown. If you wish additional information, write to the Director of Professional Personnel, University of California Radiation Laboratory, Livermore, California.

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CHUCKS AND CHUCK JAWS, B5.8—1954. $1.50
Establishes controlling dimensions for all chucks from 6-in. to 36-in. diameter of both medium and heavy duty types, for an extra heavy series of chucks with serrated master jaws, for power-operated and hand-operated chucks of two-, three-, and four-jaw types.

CIRCULAR AND DOVETAILED FORMING TOOL BLANKS, B5.7—1954. $1.50
The 60 types of machines for which tool blanks and holders are provided are classified into six different groups of comparable stock capacities. Dimensions given are for (a) circular tools with threaded mounting hole for groups 1, 2, and 3; (b) circular tools with counter-bored mounting hole for groups 4, 5; (c) dovetailed tools for all six groups; and (d) circular forming and dovetailed tool holders for all six groups.

DRILL DRIVERS (Split-Sleeve, Collet-Type), B5.27—1951. $1.50
This Standard gives taper dimensions, general specifications, and the dimensions for 135 sizes of drill drivers along with the standard and optional taper number for each size.

INVOLUTE SPLINES, B5.15—1950. $3.00
Tables give dimensional and effective clearances, minor diameter fits, dimensions for both the flat root and fillet root types, basic measurements between and over pins, special pin measurements, and hob and broach dimensions. Provisions are made for allowable errors. Formulas are given for calculating pin measurements and torque capacities.

INVOLUTE SERRATIONS, B5.26—1950. $2.00
Presents a uniform, easily fabricated set of serrations. The pitches included are 10/20, 16/32, 24/48, 32/64, 40/80, 48/96, 64/128, 80/160, 128/256 complete from 6 to 100 teeth only for the first three. The Standard makes provisions for allowable errors and effective fits, and includes the basic measurements between and over pins, also tables of maximum tooth space and minimum tooth thickness.

INVOLUTE SPLINE AND SERRATION GAGES AND GAGING, B5.31—1953. $1.50
Factors affecting fits and their control, working and inspection gages, inspection methods, machining tolerances and allowable errors are among the subjects covered.

JIG BUSHINGS, B5.6—1941. (Reaffirmed 1949) $1.00
Dimensions for: Press-Fit Wearing, Renewable-Wearing and Liner Bushings.

KNURLING, B5.30—1953. $1.50
This standard covers knurling tools with standardized diametral pitches and includes dimensional relations with stock in the production of straight, diagonal and diamond knurling on cylindrical surfaces having teeth of uniform pitch parallel to the axis of the cylinder or at a helix angle not exceeding 45 deg with axis of work, such knurling being made by the displacement of the material on the surface when rotated under pressure against a knurling tool.

MOUNTING DIMENSIONS OF LUBRICATING AND COOLANT PUMPS FOR MACHINE TOOLS, B5.28—1952. $1.00
Tables give specific mounting dimensions for motor-driven centrifugal pumps, centrifugal and geared pumps, centrifugal pumps (flange mounted type), gear and vane pumps, and for mounting brackets.

PUNCH AND DIE SETS FOR TWO-POST PUNCH PRESS TOOLS, B5.25—1950. $1.50
These dimensions for back-post and diagonal-post sets cover die area, the die holder and punch holder thickness, shank diameter and lengths, guideposts and bushings, and removable punch holder shanks.

ROTATING AIR CYLINDERS AND ADAPTERS, B5.5—1954. $1.00
These adapters are for cylinders of the following sizes: 3- and 4½-in., 6- and 8-in., 10 to 18 in., and for the 20-in. air cylinder or other power-operated device having a draw rod pull of 26,000 to 40,000 pounds. The length of stroke of the cylinders, the position of the piston rod at the end of the stroke, the diameter of the piston rod, and the size of the tapped hole in the piston rod have also been standardized.

SINGLE-POINT TOOLS AND TOOL POSTS, B5.22—1950. $2.00
Standard defines and illustrates the different classes of tools, their parts, and the angles at which they are used. Dimensions include those for: tool shanks, tool post openings, and lathe center height for solid tools and tool holders, six styles of sintered carbide tips, and the tips and shanks of tipped tools.

MARKINGS FOR GRINDING WHEELS, B5.17—1949. (Reaffirmed 1953) $1.00
Covering markings only, this Standard establishes a symbol for each of the most essential characteristics of a grinding wheel and arranges them in uniform sequence.

SPINDLE NOSES FOR LATHES, B5.9—1954. $2.50
These Spindle noses are for use on tool room lathes, engine lathes, turret lathes, and automatic lathes. Dimensions cover each size and type of nose; mating backs of chucks, face plates, and fixtures; and gages for checking important dimension on spindle noses and on back of chucks, face plates, and fixtures. Tolerances are specified, each type of spindle nose is described, and recommendations are given for its use for different types of lathes.

SPINDLE NOSES AND ADJUSTABLE ADAPTERS FOR MULTIPLE SPINDLE DRILLING HEADS B5.11—1954. $1.00
Here are the general dimensions of assembly and the detail dimensions of adjustable adapter body, set screw slot, adjustable extension adapters, adjustable adapter set screw and friction lock nuts, and spindle noses. Tolerances, finish and marking are specified.

SPINDLE NOSES AND ARBORS FOR MILLING MACHINES, B5.18—1953. $1.00
Contains dimensions for ends of arbor and adapter, for spindle nose, and for draw-in bolt end; also sketches of selective types of drive key construction.

STRAIGHT CUT-OFF BLADES FOR LATHES AND SCREW MACHINES, B5.21—1949. $1.00
Gives dimensions for the height, length, and thickness of the approved four types of blades, and includes sketches to show the optional shapes for cut-off blade stock.

T-SLOTS, THEIR BOLTS, NUTS, TONGUES, AND CUTTERS, B5.1—1949. $1.50
While recommending a width of throat greater than the nominal diameter of the bolt, provisions are made for an alternative standard having the throat width equal to the nominal diameter of the bolt. Other recommendations provide for the use of a stud of a smaller size than the T-bolt for the corresponding slot; that T-bolts, nuts, and slots be known by the diameter of the bolt, and for chamfering corners.

LIFE TESTS OF SINGLE-POINT TOOLS, B5.19—1946. (Reaffirmed 1953) $1.00
These tests apply to speed, feeds, depth of cuts, shape and size of tools, Rockwell hardness, shape and size of test logs, etc.

LIFE TESTS FOR SINGLE-POINT TOOLS OF SINTERED CARBIDE, B5.34—1956. $1.00
Recommendations apply to the tool shape, the preparation of the tools for tests, and the methods of testing to determine relationship between tool wear and cutting time. Illustrations are given showing progressive tool wear on a given type of sintered carbide tool when turning three types of steel at 700 Fpm and a Feed of 0.0077 Ipr; tool angles, and a typical cutting speed tool-life line drawn through several experimental points on Log-Log paper to give the equation $VT^n = C$.

TWIST DRILLS, B5.12—1950. $1.50
Provides dimensions and tolerances for standard straight shank drills varying from 0.0135 to 2.000 in. taper shank drills from ⅛ in. to 3½ in.; and the corresponding drill lengths and flute lengths.

DESIGNATION AND WORKING RANGES OF GRINDING MACHINES, B5.32 and 33—1953. $1.00
Provides a method of identifying machine tools so that a user can specify reasonable similar sizes and capacities by means of simple designation. The section on reciprocating table surface grinders covers all sizes having horizontal spindles, and recommends the wheel sleeve diameters, width and length of working surface, the longitudinal transverse and vertical travel. The second section deals with the swing of plain cylindrical grinding machines up to and including the 36 inch size.

MACHINE TAPERS, B5.10—1953. $1.50
Presents basic dimensions for 22 sizes of self-holding tapers; detailed dimensions and tolerances for self-holding taper shanks and sockets, for the plug and ring gages applying to this series of tapers; and the dimensions for 12 sizes of steep machine tapers.

MACHINE PINS, B5.20—1954. $1.00
These dimensions are for: hardened and ground dowel pins, straight pins, ground dowel pins (not hardened), taper pins, clevis pins, and cotter pins. An appendix gives specifications for taper pins and a drill chart for the size of drill and number required.

MILLING CUTTERS, B5.3—1950. $3.00
Reflecting the developments in cutter design, tool material, and machine improvements are the 56 illustrated types for which dimensions are here given.

REAMERS, B5.14—1949. $2.00
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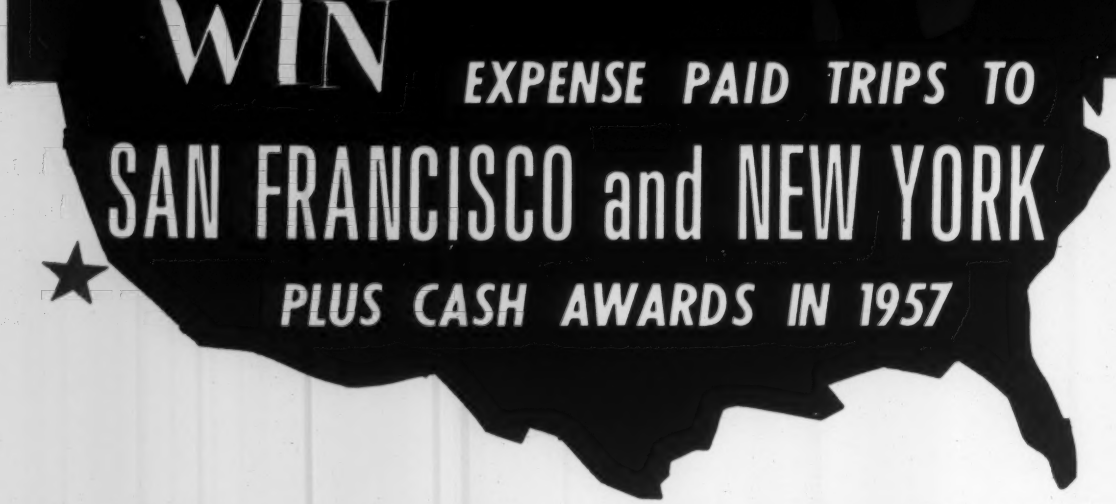

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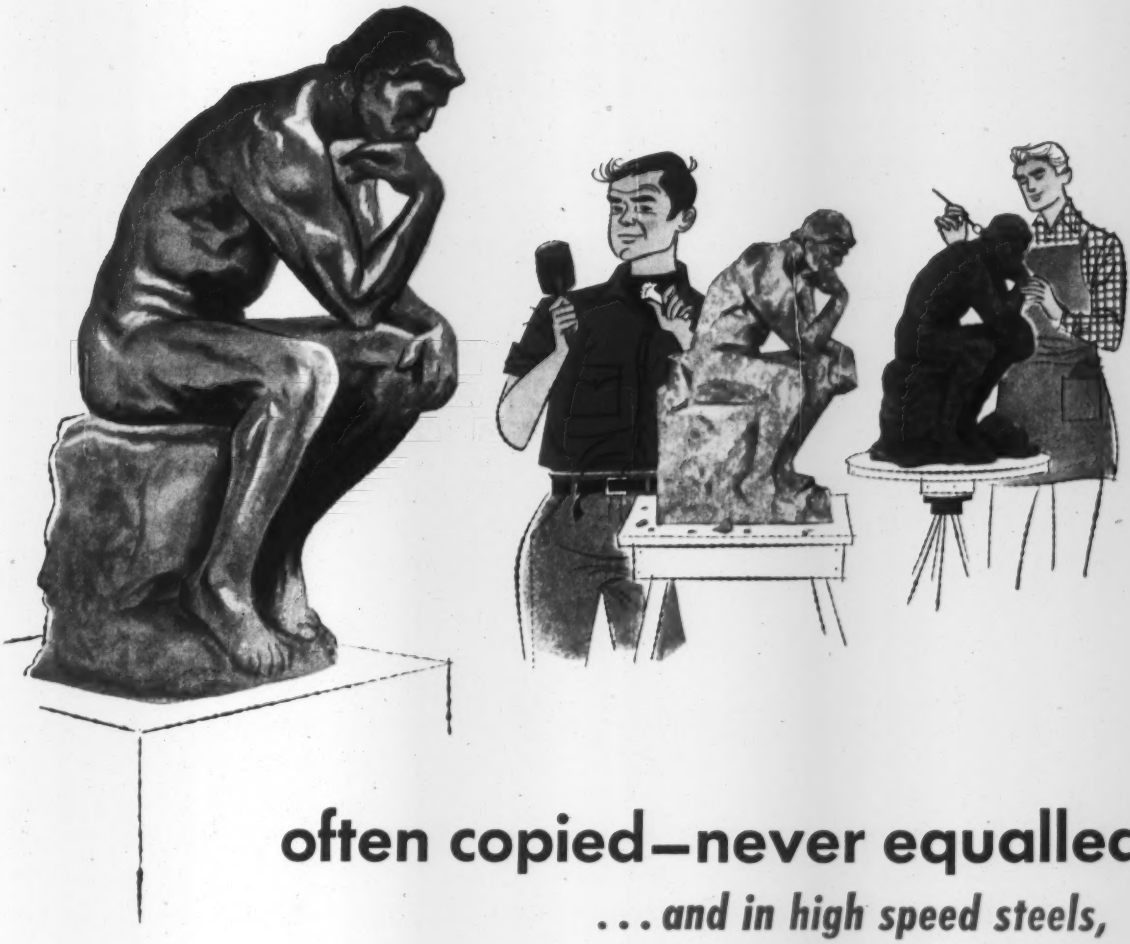

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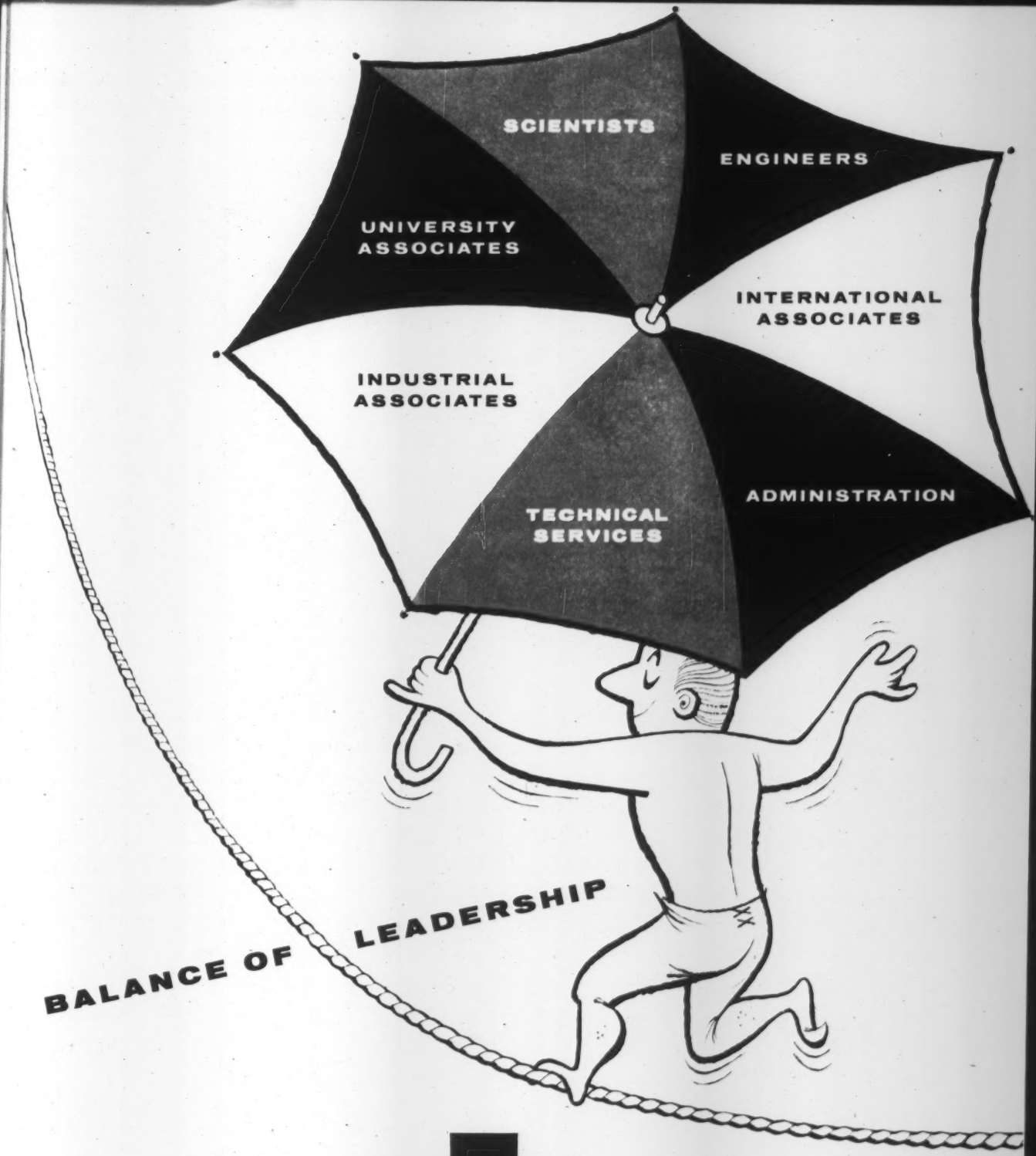

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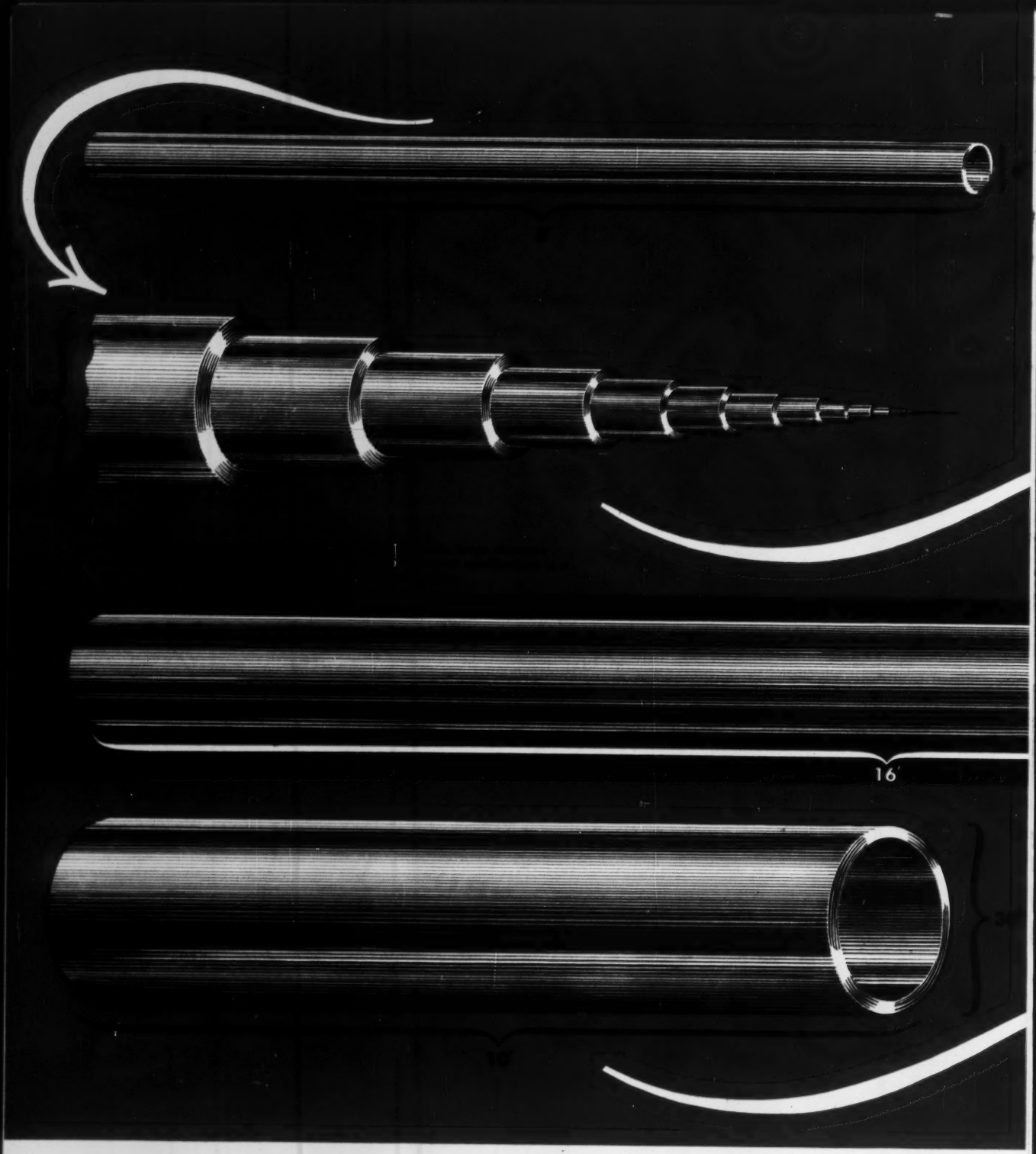

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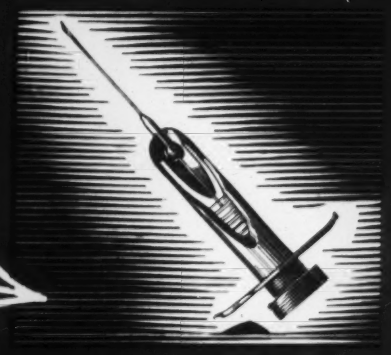

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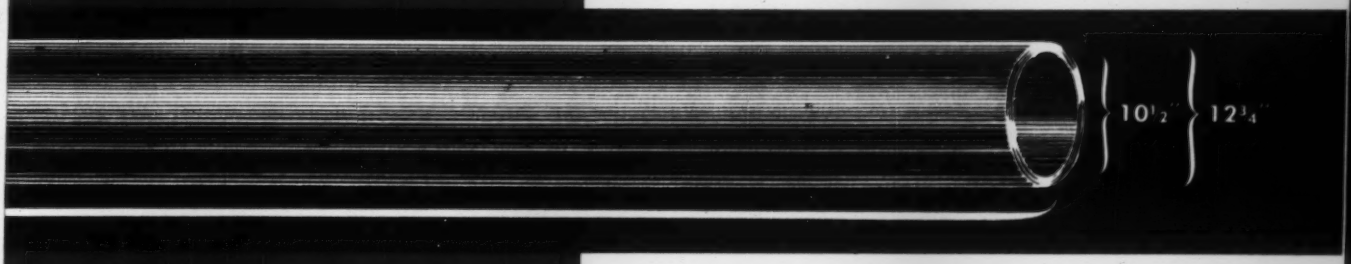

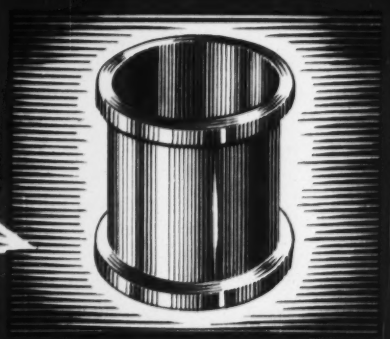

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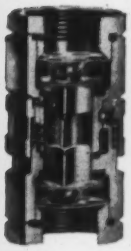

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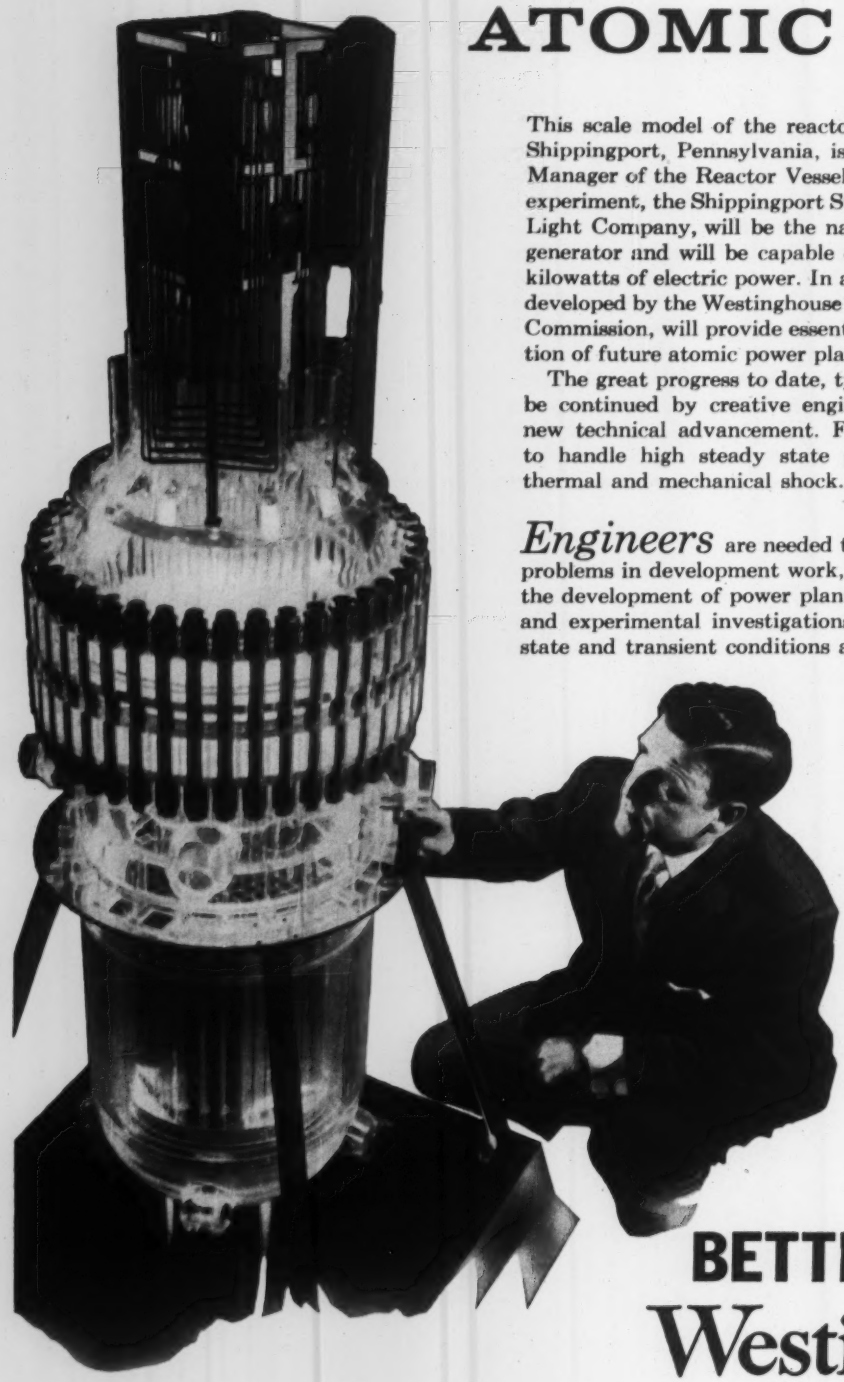

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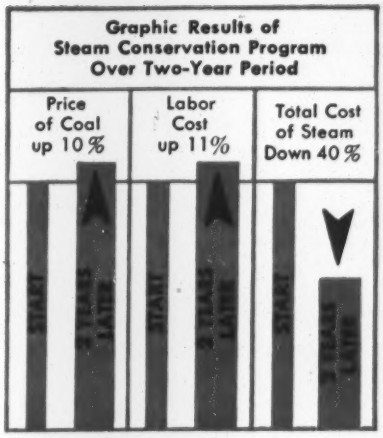

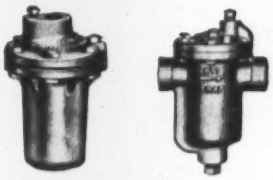

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Armstrong Traps were a "Major Factor" in Steam Conservation Says Chief Engineer

Steam waste has a way of creeping up on you. Especially in older plants. The losses can make a staggering total.

Plants looking for a way to fight rising costs can well take a page from the 8-point steam conservation program that netted a major chemical plant $100,000 annual saving:

1. **Waste steam utilized** — all flash steam recovered for building heating.
2. **New steam traps installed** — Armstrong traps replaced old traps throughout the plant, indoors and out.
3. **Steam leaks repaired.**
4. **Insulation repaired.**
5. **All condensate recovered.**
6. **Steam piping simplified.**
7. **Steam turned off when not needed.**
8. **Preventive maintenance improved** to insure a continuous checkup on sources of waste.

In commenting on the program, the Chief Engineer of the plant stated, "*4000 new Armstrong steam traps were one of the major factors in conserving steam. The traps, plus improved installation practice, have reduced annual trap maintenance parts and labor by $25,000 as compared to traps previously used.*"

Want all the facts? Tips on cost-saving standardized trap hookups? Facts about Armstrong traps? Ask for:

1. The No. 1, 1956 issue of the Armstrong Trap Magazine containing complete details, drawings and photos.
2. The 44-page Armstrong Steam Trap Book, a fact-full guide to better trapping.

Call your local Armstrong Representative or write:

ARMSTRONG MACHINE WORKS
8942 Maple St., Three Rivers, Michigan

ARMSTRONG STEAM TRAPS

DONALD C. POWER

Portrait By Fabian Bachrach

General Telephone shows gain of 140% in Payroll Savings Plan

"The qualities of thrift and good management are just as important to the individual worker as they are to the man who operates a business. Setting aside a little of what you earn today for emergencies or future plans is sound policy for everyone.

"That's why I am so enthusiastic about the way our General Telephone System employees have been purchasing U.S. Savings Bonds by the Payroll Savings Plan. In a recent person-to-person canvass which put Payroll Savings Application Blanks in the hands of our employees, enrollment in our Payroll Savings Plan increased from 5,838 to 14,156—a gain of 140%.

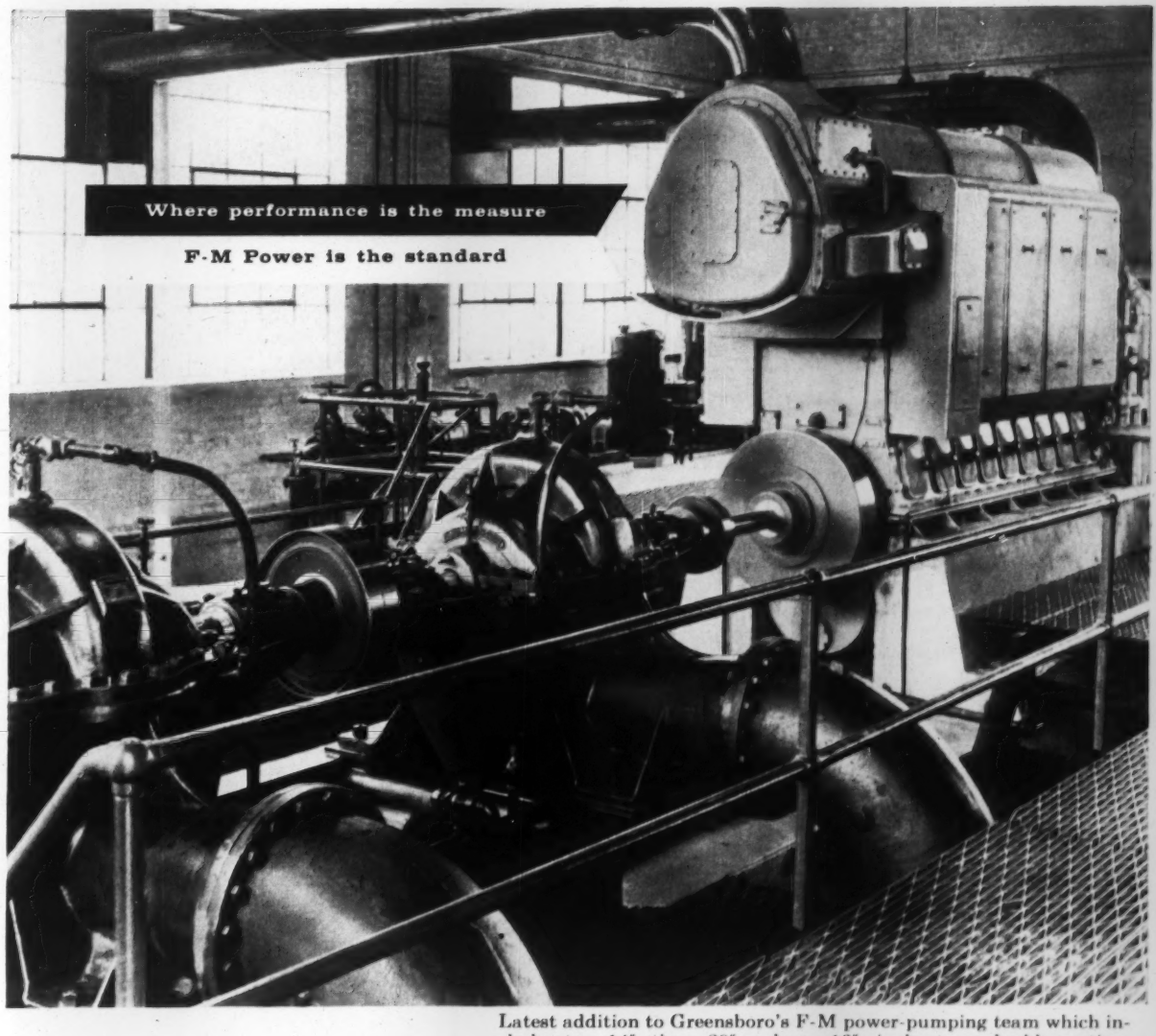
"It is fortunate that the world's safest investment benefits both the buyer and the United States Government that serves and protects him."

DONALD C. POWER, ***President***
General Telephone System

Encouraging *your* employees to join *your* Payroll Savings Plan is good business for *you, them* and *your* country. Your State Director will gladly help you install a Payroll Savings Plan or revitalize a present one. Phone or write the Savings Bonds Division, U.S. Treasury Department, Washington 25, D. C.

The United States Government does not pay for this advertising. The Treasury Department thanks, for their patriotic donation, the Advertising Council and

MECHANICAL ENGINEERING



Latest addition to Greensboro's F-M power-pumping team which includes two 14", three 20" and one 16" single-stage, double-suction, centrifugal pumps. All are driven by O-P diesels totaling 3175 hp.

Greensboro Saves $46,300 Yearly with Fairbanks-Morse Power-Pumping Team

Increased capacity at operating costs that are lower by 55% — that is the record set by 3100 hp. of Opposed-Piston diesels and the six F-M pumps they drive in the water system of Greensboro.

Such a "required standard" of performance has been set by F-M diesel and dual fuel engines in all classes of municipal service the country over. Apply the measure of performance to your power requirements and see what the F-M standard of dramatic economies in operating costs can save you.

Fairbanks, Morse & Co., Department ME-4, Chicago 5, Illinois.

FAIRBANKS-MORSE
a name worth remembering when you want the BEST

Diesel and Dual Fuel Engines . Diesel Locomotives . Rail Cars . Electrical Machinery . Pumps . Scales . Home Water Service Equipment . Mowers . Magnetos

Six choices of corrosion resistant tubes and sockets

4130 alloy steel tube with alloy steel tip and socket.

403 stainless steel tube with alloy steel tip and socket.

403 stainless steel tube with 416 stainless tip and socket.

316 stainless steel tube with alloy steel tip and socket.

316 stainless steel tube with 303 stainless tip and socket.

Monel tube with alloy steel tip and socket.

Tubes and sockets listed above are available in Type 100 Mastergauges which are designed for extreme service and pressures. Type 101 Mastergauges, for medium and high pressures, are available with:

4130 alloy steel tube, with alloy steel tip and socket.

403 stainless steel tube, with 416 stainless steel tip and socket.

403 stainless steel tube with alloy steel tip and socket.

STAINLESS...from socket to tip

Another Marsh development! The superlative Mastergauge is now available with stainless and alloy steel bourdon tubes. Try to find a corrosive service that isn't covered by range of materials listed above.

Tube, socket and tip—every part subjected to a corrosive medium —are fused into one piece by the "Connoweld" process . . . the exclusive process that distinguishes the Marsh Mastergauge from all other gauges.

Whether you need a gauge for corrosive service or any other critical application, Mastergauge is the one correct answer. It gives you the leak-proof Connoweld construction, the stronger, more durable copper-clad Marshalloy case, the precision Mastergauge movement, the "Recalibrator" to preserve its unmatched accuracy. Ask for data covering your specific gauge needs.

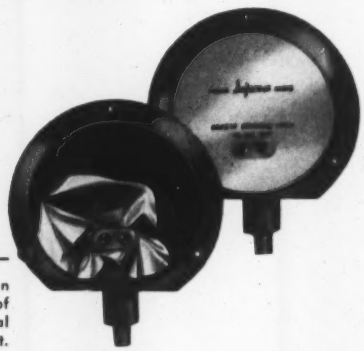
MARSH INSTRUMENT CO. Sales Affiliate of Jas. P. Marsh Corp. **Dept. 29, Skokie, Ill.**
Marsh Instrument & Valve Co. (Canada) Ltd. 8407 103rd St., Edmonton, Alberta
Houston Branch Plant: 1121 Rothwell St., Sect. 15, Houston, Texas

MARSH GAUGES

"THE STANDARD OF ACCURACY"

Stainless steel tube in the new SAFECASE

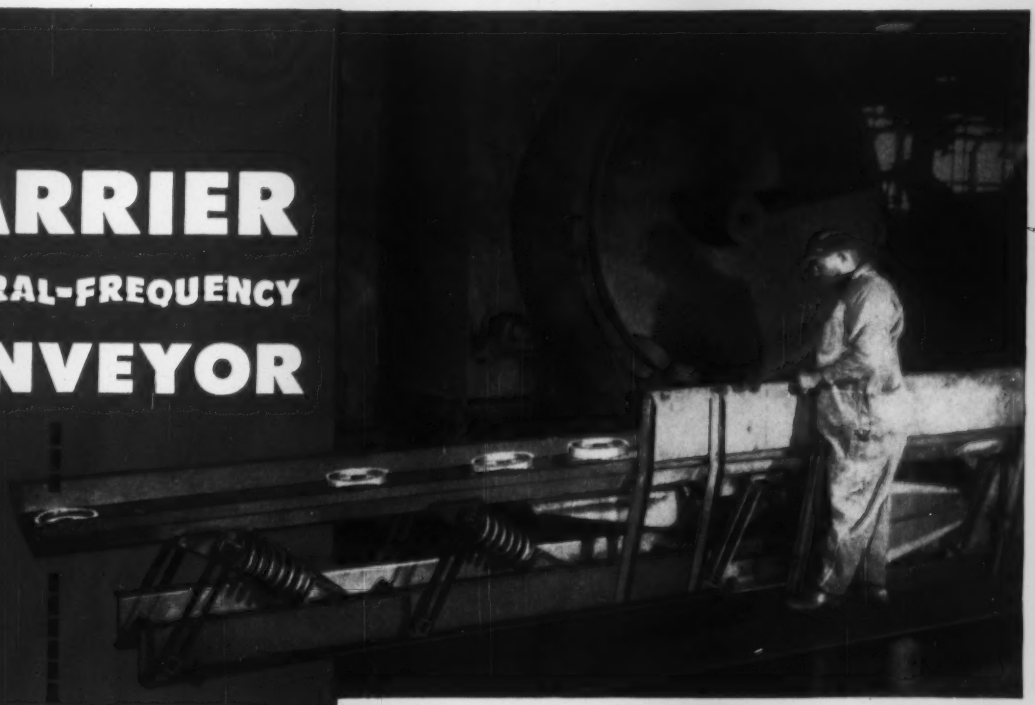
Here is a great combination . . . Marsh Mastergauge with corrosion-resistant bourdon tube in the revolutionary Marsh Safecase . . . everything it takes for corrosive service where a surge of overpressure can occur.



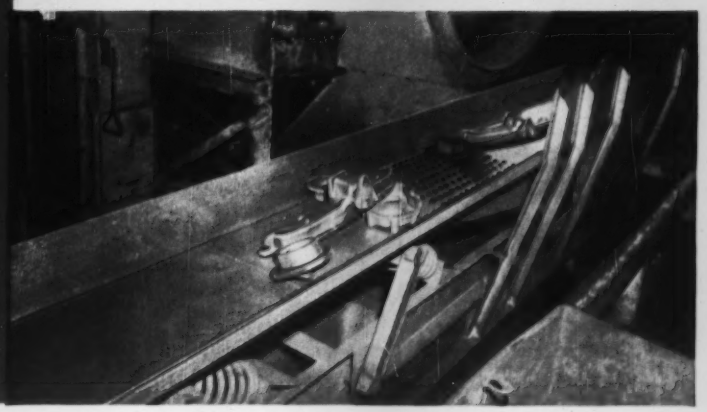
Explosive force merely opens safety back—

Photo shows result of laboratory test in which gun cartridge was discharged in rear compartment of Safecase. Thin, tough back yields to abnormal pressure, but cannot be dislodged by blowout. Front of gauge remains intact, protected by heavy metal barrier.

CARRIER
NATURAL-FREQUENCY
CONVEYOR



TAKES HEAT, IMPACT AND ABRASION IN STRIDE!



HERE you see a 15′ Carrier Natural-Frequency Conveyor at work underneath a Pangborn Rotoblast "Continuous-Flo" Barrel in International Harvester's Indianapolis plant. It puts in a rugged 16-hour day conveying 320 tons of hot gray-iron castings, including heavy water-pump housings, flywheels, retaining rings and other engine parts.

Foundry applications are only one of the many uses for Carrier Conveyors. Others include bulk chemicals, cement, ores, mill scale and slag, food products and machine turnings — all of which are now being successfully conveyed and processed by Carrier Natural-Frequency Vibrating Equipment. Write for Bulletin 112. Carrier Conveyor Corporation, 251 North Jackson Street, Louisville 2, Kentucky.

CARRIER CONVEYOR ABOVE HAS FOUR BIG ADVANTAGES OVER PREVIOUS METHOD:

1 Vibration of unit accomplishes far better job of shot removal.

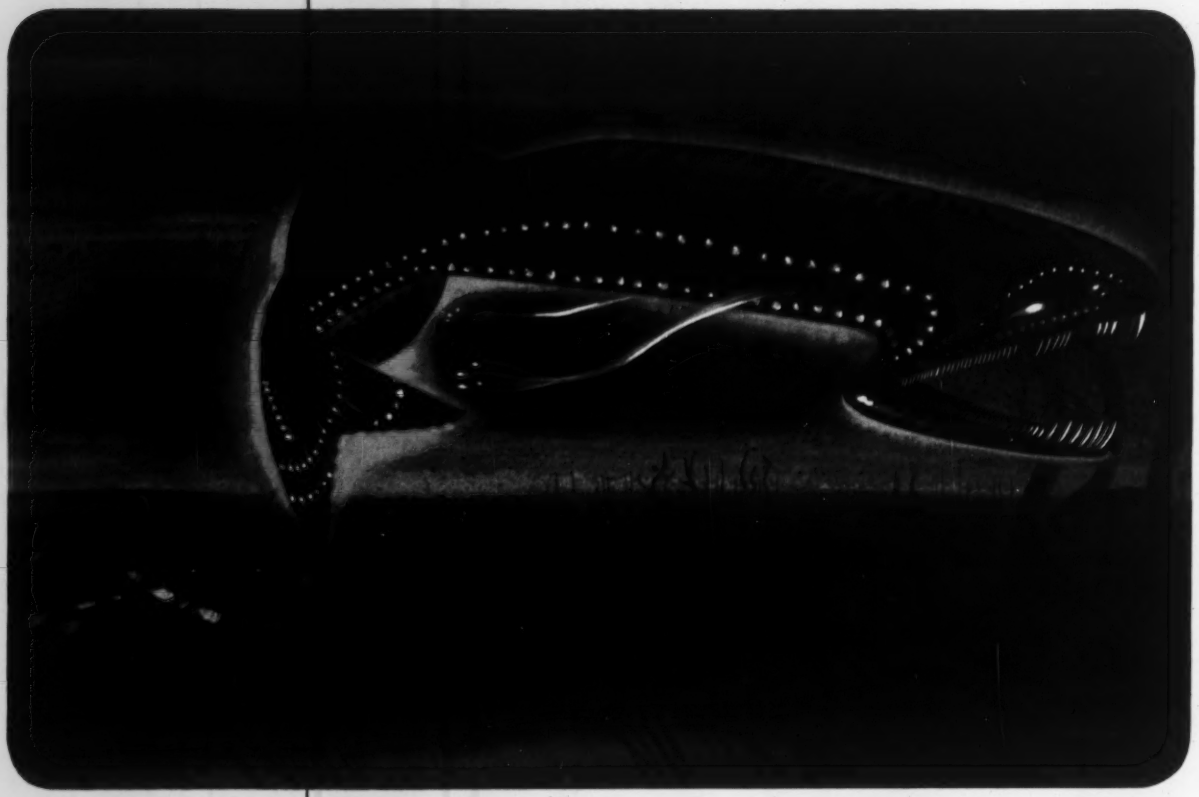
2 Instead of bunching up, castings now move quickly and evenly down conveyor, for easier sorting.

3 Heavy steel-plate trough resists impact, heat and abrasion, making maintenance costs negligible compared to a belt.

4 Patented Carrier Natural-Frequency drive uses heavy coil springs as drive units. Result — low input horsepower, uniformly distributed operating stresses, and a *minimum of mechanical maintenance.*

CARRIER CONVEYOR CORPORATION, LOUISVILLE 2, KENTUCKY

IMPORTANT DEVELOPMENTS AT JPL



The Jet Propulsion Laboratory is a stable research and development center located north of Pasadena in the foothills of the San Gabriel mountains. Covering an 80 acre area and employing 1700 people, it is close to attractive residential areas.

The Laboratory is staffed by the California Institute of Technology and develops its many projects in basic research under contract with the U.S. Government.

Opportunities open to qualified engineers of U.S. citizenship. Inquiries now invited.

Designed for Its Environment

In the creatures of the deep sea, Nature has provided us with many examples of structures designed for their environment. We at JPL are faced with a comparable problem in designing missile structures to withstand the forces of their environment. In addition, our solutions must be produced in far less time than Nature allows herself.

With each new development, the environment in which missiles must survive grows increasingly severe. Hence, we are not only working toward better solutions of the same problem, but toward practical solutions of even bigger, more complex problems.

Integrated missile system design requires the concentrated capabilities of many qualified people. The research and development in which JPL is engaged demands scientists and engineers who can do real creative work in the fields of aerodynamic heating, analytical structures investigations and advanced material uses.

These problems are all challenging in nature and require individuals vitally interested in mathematics, physics and their application to our particular problems. Our interest is in men who put ideas and thinking ahead of routine analysis, and wish to carry on their efforts in an atmosphere of scientific engineering and mutual collaboration.

If you are interested in becoming a part of this stimulating design and development program send your resume now for immediate consideration.

JOB OPPORTUNITIES IN THESE FIELDS NOW

jpl

AERONAUTICS • MECHANICAL • STRUCTURES • DYNAMICS • PROPULSION
APPLIED MECHANICS • INERTIAL ELEMENTS • METALLURGY • CERAMICS
SOLID STATE PHYSICS • OPERATIONS RESEARCH

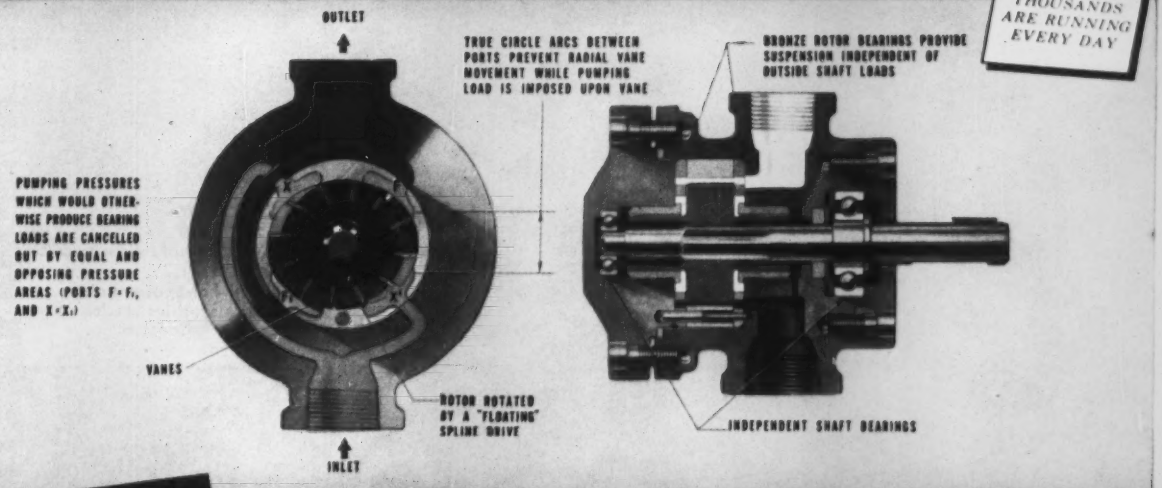
JET PROPULSION LABORATORY

A DIVISION OF CALIFORNIA INSTITUTE OF TECHNOLOGY

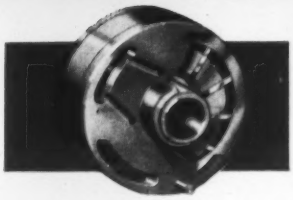
PASADENA • CALIFORNIA

Question: Why are VICKERS Balanced Vane Type Pumps the most widely used oil hydraulic power pumps?

HUNDREDS OF THOUSANDS ARE RUNNING EVERY DAY


OUTLET
TRUE CIRCLE ARCS BETWEEN PORTS PREVENT RADIAL VANE MOVEMENT WHILE PUMPING LOAD IS IMPOSED UPON VANE
BRONZE ROTOR BEARINGS PROVIDE SUSPENSION INDEPENDENT OF OUTSIDE SHAFT LOADS
PUMPING PRESSURES WHICH WOULD OTHERWISE PRODUCE BEARING LOADS ARE CANCELLED OUT BY EQUAL AND OPPOSING PRESSURE AREAS (PORTS F-F1, AND X-X1)
VANES
ROTOR ROTATED BY A "FLOATING" SPLINE DRIVE
INDEPENDENT SHAFT BEARINGS
INLET

Answer: Because of their SUPERIOR PERFORMANCE and MANY OTHER BENEFITS for the user.



For more than two decades, the Vickers Balanced Vane Type has held the leading position among hydraulic power pumps . . . growing steadily in popularity. The various models (see below) are *the most widely used of all pumps in oil hydraulic service.*

Above is the pumping cartridge which is one of this pump's distinctive features. The many advantages listed at the right merit the thoughtful attention of anyone concerned with the selection and use of oil hydraulic pumps.

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Machinery Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
Department 1500 • Detroit 32, Michigan
Application Engineering Offices: ATLANTA • CHICAGO • CINCINNATI • CLEVELAND • DETROIT • GRAND RAPIDS • HOUSTON LOS ANGELES AREA (El Segundo) • MINNEAPOLIS • NEW YORK AREA (Summit, N. J.) • PHILADELPHIA AREA (Media) PITTSBURGH AREA (Mt. Lebanon) • PORTLAND, ORE. ROCHESTER • ROCKFORD • SAN FRANCISCO AREA (Berkeley) SEATTLE • ST. LOUIS • TULSA • WASHINGTON • WORCESTER
IN CANADA: Vickers-Sperry of Canada, Ltd., Toronto

COMPLETE HYDRAULIC BALANCE—Each inlet and outlet port is balanced by another equal in size and radially opposite . . . pressure-induced bearing loads are thus eliminated. Pressure-balanced porting plates maintain ideal running clearances.

FLOATING SPLINE DRIVE—Rotor is driven by a "floating" spline. Rotor and shaft have separate bearings . . . avoiding strain from drive misalignment.

TRUE-CIRCLE CAM ARCS between ports prevent radial vane movement while pumping load is imposed upon vanes. Wear between vanes and rotor is thus practically eliminated.

ABILITY TO TOLERATE DIRT—Clean oil is of great importance in a hydraulic circuit; but, in spite of care, dirt sometimes gets in. The Vickers Vane Type Pump will pass a reasonable amount of dirt without trouble and without grinding it up.

REPLACEABLE CARTRIDGE—Cartridge (illustrated above left) contains all pumping parts that move . . . none contact the housing. Working parts can be removed and inspected without disconnecting piping or drive coupling. Replacement cartridge kits are available and pumps need not be sent to the factory for repairs. Pump capacity can be changed by simply changing cartridge in the field.

HIGHER EFFICIENCY—Tests prove exceptionally high volumetric and overall efficiency . . . not only when pump is new but also after long service.

AUTOMATIC WEAR COMPENSATION—Vanes are held in contact with the cam ring by centrifugal force and hydraulic pressure. If wear occurs, vanes revolve in a slightly larger orbit without appreciable change in performance.

MINIMUM MAINTENANCE—Hydraulic balance . . . floating spline drive . . . independent bearings . . . automatic wear compensation eliminate the most important causes for maintenance and repair.

TEMPERATURE ADAPTABILITY—Correct running clearances are automatically maintained which compensate for wide variation in oil viscosity resulting from temperature variation.

LONGER LIFE—The numerous features mentioned above that keep down maintenance also contribute to longer life. Then, a new cartridge completely rejuvenates the pump.

CONSTRUCTION SIMPLICITY is evident from the illustrations above. This simplicity is another reason for the superiority of Vickers Vane Pumps. For further information, ask for Bulletin 5002A.

7182

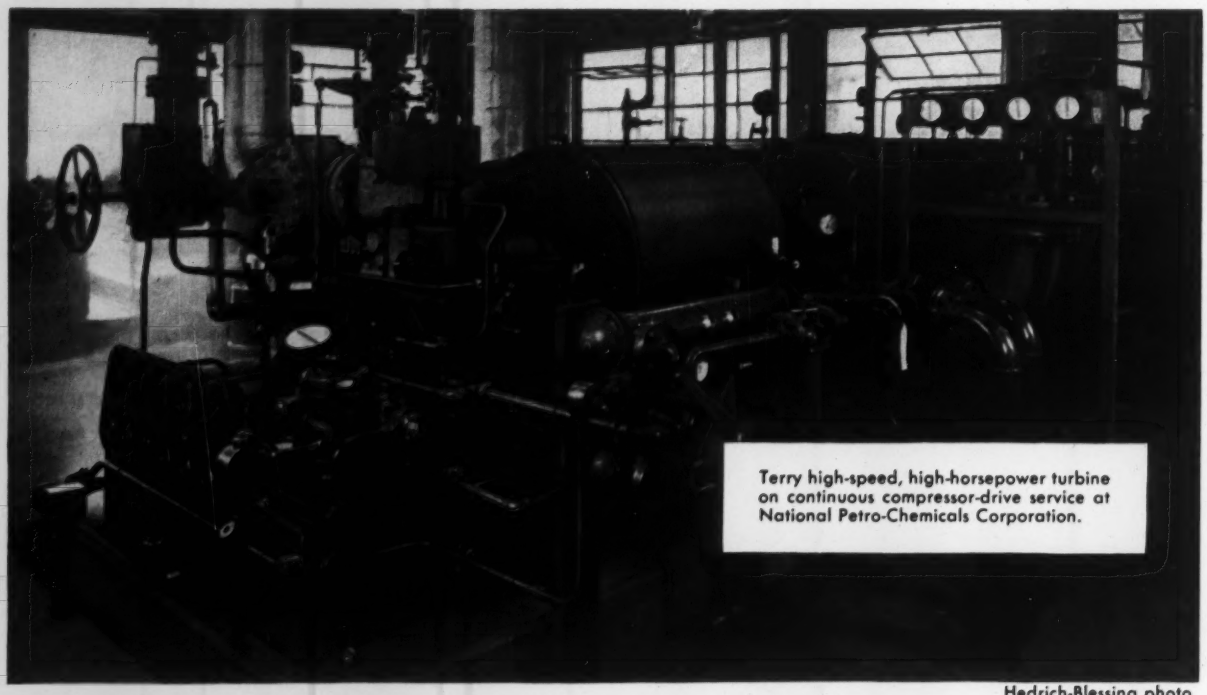
ALL MODELS HAVE THE VICKERS ADVANTAGES MENTIONED ABOVE

Single Stage. Pressures to 1,000 psi. Capacities to 55 gpm.

Two Stage. Pressures to 2,000 psi. Capacities to 55 gpm.

Double Pump—Two pumps for separate circuits driven by common shaft.

Two-Pressure Pump automatically delivers larger volume at low pressure and smaller volume at high pressure.

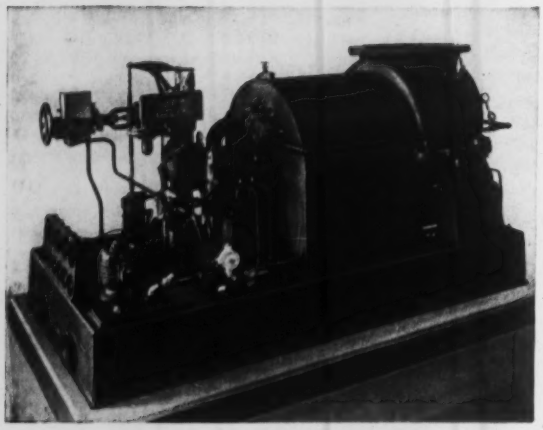


Terry high-speed, high-horsepower turbine on continuous compressor-drive service at National Petro-Chemicals Corporation.

Hedrich-Blessing photo

At National Petro-Chemicals Corporation . . .

Terry high-speed compressor-drive turbines provide continuous 'round-the-clock service



One of the two 5400 hp., 7486 rpm turbines built for the Tuscola plant of National Petro-Chemicals Corporation.

In the fall of 1953, five Terry multistage turbines were placed on day-and-night duty at the Tuscola, Illinois, Plant of National Petro-Chemicals Corporation. They drive high-speed compressors used to compress hydrocarbon gases in the production of ethylene.

The *excellent performance of these initial units later resulted in the installation of two more Terry machines.* These were placed in service some two years later.

In all, the seven turbines total more than 30,000 hp. They range in capacity from 3300 to 5400 hp., and in speed from 7500 to 9700 rpm.

The National Petro-Chemicals installation, and the thousands of other units serving in refineries and chemical plants throughout the world, are testimony to the low maintenance and consistent reliability of Terry turbines. Put Terry to work for you. Write for further information.

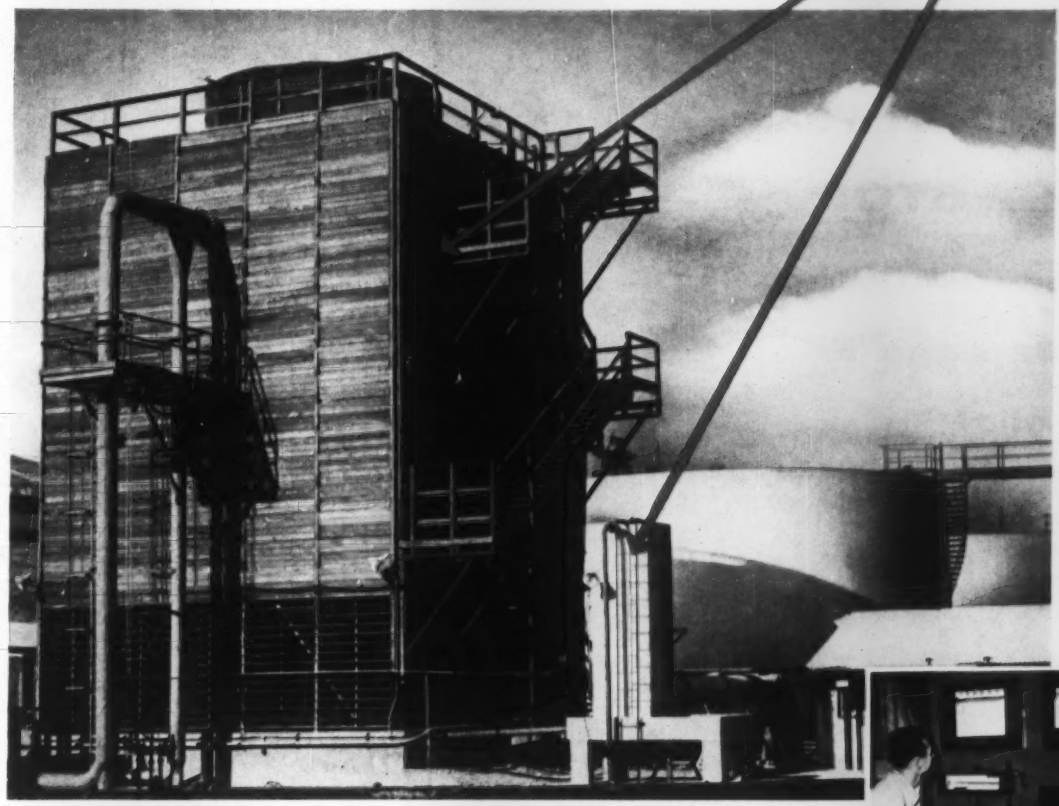
THE TERRY STEAM TURBINE CO.

TERRY SQUARE, HARTFORD 1, CONN.

TERRY

TT-1207

TESTING—1, 2, 3



This New Foster Wheeler
COOLING TOWER TEST CENTER
is your assurance of
higher cooling efficiency and long tower life

OVER 40 years of experience notwithstanding, *research* continues to play an important part in Foster Wheeler cooling tower work. Latest addition to FW cooling tower research facilities, is the fully equipped test center shown above. Here every detail of design is subjected to exhaustive and precisely measurable tests under conditions identical to those encountered in actual service. In addition to proving the superior thermal and mechanical design of FW Cooling Towers, this research is continually helping to develop new and improved construction methods and materials, for higher performance standards and longer cooling tower life.

For complete information on the new line of Foster Wheeler Induced-Draft, Counter-Flow Cooling Towers, send for Bulletin No. *CT-56-11. Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

1 Large Commercial Size Cooling Tower, 30′ by 30′ ground area and 44′ height, with removable casing panels for testing of various materials. Includes provision for measuring temperatures, pressures, water and air flow throughout the tower, with the ability to vary these conditions over a wide operating range.

2 Small-scale Pilot Tower for preliminary exploration.

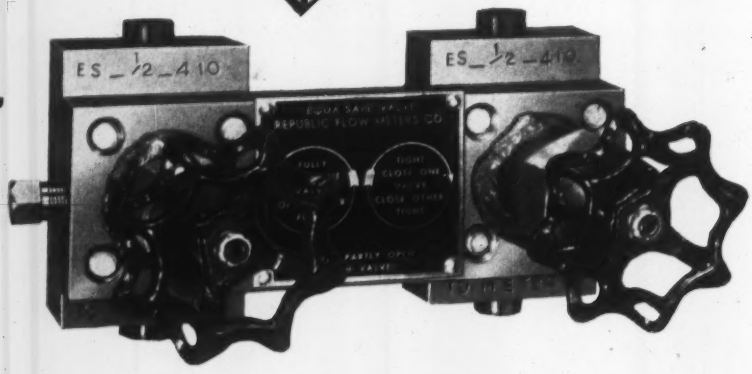
3 Complete Indicating and Recording Instrumentation facilities for precise measurement of all tower test and psychrometric data.

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

NOW AVAILABLE

Valve Manifolds that STOP Mercury Blowing, Damage to Differential Bellows and Diaphragms



- **CANNOT throw full line pressure across bellows, mercury or diaphragms of ΔP instruments.**
- **Replaces 3 or 4 conventional shut-off valves, fittings, etc.**
- **Rated to 4000 psi (cold)**
- **Available with angle, 3-way or through-type bodies threaded or socket- welded connections.**

No conventional built-up valve manifold affords the protection EQUA-SAFE *automatically* gives to differential pressure type instruments. And no built-up valve manifold can beat the low installation time or low maintenance required by EQUA-SAFE valves.

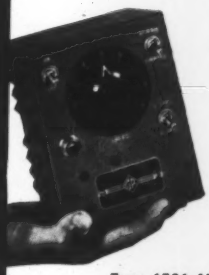
The "secret" of EQUA-SAFE's protection is in the common bridge-type bonnet and the two double-seating valves it connects. *When either valve is operated* (and sequence does not matter) *pressures in the two chambers of the differential instrument are automatically equalized through the bonnet.* As soon as both valves are fully "opened" (stem out) the instrument is on the line, with no leakage between sides. When both stems are in, the instrument chambers are interconnected and completely sealed off from primary connection pressures. Teflon packings are under pressure only while the stems are traveling from "seat" to "backseat", or vice versa!

Standard EQUA-SAFE valve manifolds are made of carbon and/or stainless steel, depending on your requirements. If your requirements are unusually severe, remember that EQUA-SAFE valves can be made of *any bar stock material that can be machined and welded!* When inspection or maintenance are needed, this bolted-block construction pays off again. EQUA-SAFE valves can be completely dismantled without breaking any pipe connections, and the inlet seat can be dressed up in place. A reversible backseat ring gives double wear, and is merely turned upside down to present a brand new seat.

Get the entire story on what EQUA-SAFE valves can do for your differential instrument installations. Write for Republic Bulletin No. 56-1, or ask your Republic engineer. Now that there is a top-quality instrument valve manifold for ΔP instuments, you should definitely investigate its applications in your plant.

REPUBLIC FLOW METERS CO.

2240 Diversey Parkway, Chicago 47, Illinois

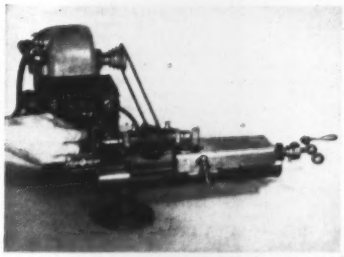


Type 1701-AK for 1/15th hp Shunt-Wound D-C Motors. Type 1701-AU similar, for Series or Universal Motors

Variac®
Motor Speed Controls

Type 1705-B for 1½ hp d-c Motors, Compound with Interpoles

for Perfectly Smooth Operation at Any Speed on Thousands of Applications



Jewelers Lathe

High-Speed Resistance Card Winding

Photo Courtesy The Arnold Engineering Company, Marengo, Ill.
Toroidal Tape Core Winding Machine

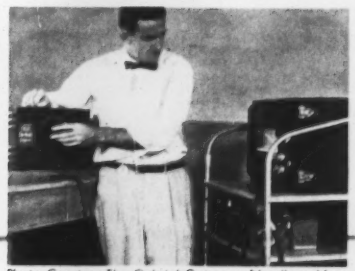


Photo Courtesy The Gabriel Company, Needham, Mass.
Controlling Rotation of Shipboard Radar Antenna

- ★ D-C Motors from A-C Lines
- ★ Full Torque at ANY Speed from full speed to stall
- ★ Smooth Control from zero to full rated with constant torque — no jumpiness — no instability even at the lowest speeds
- ★ Instant Starting — no electron tubes — no warm-up
- ★ Extra-Fast Reverse — dynamic braking on all models larger than 1/15th hp
- ★ High Starting Torque permits quick start under heavy loads
- ★ Ideal for Production where frequent starting and stopping required
- ★ Simple to Install — Reliable — Low Cost — Very Long Life — Little and Simple Maintenance
- ★ Fifteen Models for d-c motors from 1/15th hp to 1½ hp — priced from $85 to $270. Quantity discounts on most units.

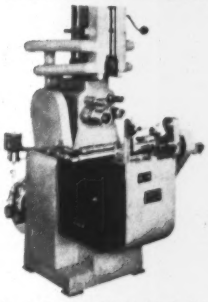


Photo Courtesy W. M. Steele Co., Worcester, Mass.
Hot Stretching Machine for Nylon Thread

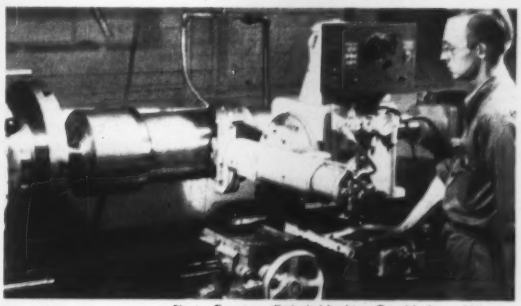


Photo Courtesy Gisholt Machine Co., Madison, Wisc.
Superfinishing and High-Speed Metal Polishing

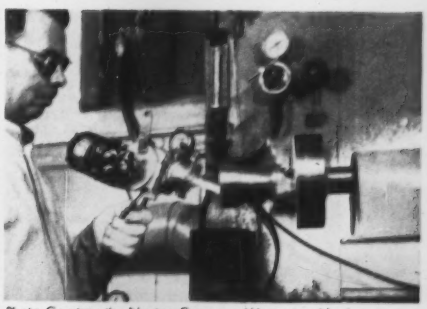


Photo Courtesy the Norton Company, Worcester, Mass.
Ceramic Spray Gun

General Radio Company, 275 Massachusetts Ave., Cambridge 39, Mass.

Please send a copy of the G-R VARIAC Motor Speed Control Bulletin.

Name.....(617)

Company.....

Street.....City.....State.....

Engineers' Reference Books

Published by
The American Society of Mechanical Engineers

TRANSACTIONS OF THE ASME FOR 1956

Published April 1957. $15.00 ($7.50 to ASME members).—It is in this 2500-page book that you will find information that may well point the way to success with your engineering problems. Here, in some 240 carefully prepared articles, are reports of important investigations, surveys of significant trends, accounts of recent technological developments that have been used successfully by other engineers, and a unique collection of factual information and data. Among the many problems dealt with are those associated with: Bearings, Beams, Columns, Structures, Buckling, Cavitation, Cooling Systems, Elasticity, Feedwater Treatment, Flow of Fluids, Fluid Meters, Forgings, Gas Turbine Power, Graphical Methods, Heat Exchange Equipment, Heat Transfer, Hydrodynamics, High Temperature Materials, Pressure and Temperature Instruments, Lubricants and Lubrication, Machine Tools, Metal Cutting, Metal Creep—Failure—Forming—and Testing, Nondestructive Testing, Plates and Shells, Plasticity, Pneumatic Drives, Pumps, Outdoor Power Plants, Gas Turbine—Hydraulic—Industrial—Nuclear—and Steam Power Plants, Servomechanisms, Stresses and Strains, Thermal Stresses, Thermodynamics, Turbomachinery, Vibration.

DYNAMICS OF AUTOMATIC CONTROLS

Published 1948. $6.00.—A book for both the practical and theoretical worker, it discusses the dynamic properties which all controllers possess in common, provides information on the functional elements of a control and the mathematical methods for handling control problems. It considers the important components of the control loop and special control problems. The causes of nonlinearities in the control loop, and the on-off regulator and its field of application are studied, also the theory of the excursion-dependent periodic controller. Appendixes list formulas for the Laplace transformation, for difference equations, and for typical elements and combinations of the dynamical circuit.

FREQUENCY RESPONSE

Published 1956. $7.50.—Design technique based on frequency response is now a prime analytic tool in numerous branches of modern techniques and FREQUENCY RESPONSE offers an unparalled amount of information on this tool. Covering the entire field from basic theory to experimental techniques, this book orients the reader in regard to historical developments, fundamental theory, and significant advances; describes frequency response aids such as types of sine wave generators for obtaining data, slide rules and nomographs for facilitating computation; discusses and illustrates the application of experimental methods of frequency response to process controls, servomechanism design and power systems; covers process control behavior, transient response, optimum control, nonlinear techniques, sampling controls and statistical approach to servomechanisms and regulators.

SHOCK AND VIBRATION INSTRUMENTATION

Published 1956. $5.00.—This book provides a fund of useful information on recent advances and new concepts in the technology of shock and vibration. Among the subjects discussed are random vibration, effect of non-rigid structures on vibration isolation, hysteresis and slip damping, vibration and shock testing, design approaches and analog methods.

DESIGN DATA AND METHODS

Published 1953. $4.00—This 200-page compilation includes formulas and methods of calculating stresses in beams, bars, columns, plates, shafts, and crane hooks; stress component formulas; procedures for computing stresses and deformation in pressure vessels; design data on press- and shrink-filled assemblies and also for piping; factors of working stresses; numerical values of tangential stress in thick-walled cylinders; numerical solution of problems of gas flow when properties change continuously; method of characteristics for two dimensional supersonic flow; chart for oblique shock waves under water; accurate bearing calculations; and methods of treating and solving problems of vibration and balancing of rotating apparatus.

DESIGN ENGINEERING—Training in Value Analysis, Selection of Engineering Materials, Miniaturization Trends, Rewards.

Published 1956. $3.50—As the title implies, there is a wealth of information based on actual experience in this book for those interested in the training of design engineers in value analysis, provisions for rewarding them for outstanding achievements, design and selection of engineering materials, and the effect of the trend toward miniaturization.

METALS ENGINEERING-DESIGN

Published 1953. $10.00—This book discusses the essential properties which need to be evaluated by the design engineer in his selection of one material over another. Comprising 48 sections and written by 43 well-known authorities, it deals with the over-all problem of selection of material and takes up such specific items as high temperature considerations, plasticity, residual stresses, vibration, fatigue, shot peening, cold working, nitriding, flame strengthening, impact, corrosion, non-destructive testing, surface finish and mass production, and design theory and practice.

METALS PROPERTIES

Published 1954. $11.00—Provides, in convenient charts and tables, data on a broad range of metals in common industrial use—AISI steels, ASTM steels, cast copper alloys, aluminum alloys, tin, magnesium, etc. Tabulated under each of the more than 500 metals listed in such information as the chemical composition of the metal; its brittleness, heat treatment and other characteristics; its industrial uses; treatment temperatures for forging, annealing, quenching, etc.; such technological properties as recrystallization temperature and hot working temperature, and a great deal of other pertinent information to help the designer choose the proper metal for each part or product.

ENGINEERING TABLES

Published 1956. $12.00—A collection of tables often wanted by engineers but not commonly found in handbooks covering: Bar Stock and Shafting. Conversion Factors. Formulas for Stress and Strain. Properties of Sections and Cylinders. Bearings. Bearing Load Analysis. Spur Gears. Helical and Herringbone Gears. Bevel Gears. Worm Gears. Cylindrical Fits. Standard Tapers. Keys and Keyseating. Bolts. Counterbores. Screw Threads. Slots. Serrations and Splines. Nuts. Pins. Snaprings. Washers. Wrench Openings. Springs. Aircraft and Mechanical Tubing. Pressure Tubes. Pipe. Pipe Threads and Fittings. Electric Motors. Graphical Symbols. Welding. Gaskets. Hydraulic Standards and Symbols. O-Rings. Packings. Seals. Bibliography.

ELEVATED TEMPERATURE PROPERTIES OF:

J—1 Copper and Copper Alloys. 1956. $5.50, $4.25*. —2 Carbon Steels. 1955. $3.75, $2.80*. —3 Selected Super-Strength Alloys. 1954. $4.75, $3.50*. —4 Chromium Molybdenum Steels. 1953. $4.75, $3.50*. Each of these reports is a graphical summary of the elevated-temperature strength data collected. Each includes summary curves of tensile and yield strength, elongation and reduction of area, rupture, and creep rates; also data sheets giving the chemical composition, processing data, heat treatment, and other pertinent information about the steels included in the respective surveys.

RELAXATION PROPERTIES OF STEELS AND SUPER-STRENGTH ALLOYS AT ELEVATED TEMPERATURES

K 1956. $4.00, $3.00*—Tabulated data and graphical presentations summarize relaxation strengths for low alloyed Mo-, Cr-, and V-bearing steels with numerous other composition modifications; 12 per cent Cr type steels with many compositional variations; a number of super-strength alloys; and cast iron. Residual stresses for relaxation to 100, 500, 1000, and 10,000 hr tabulated in this Report are the main measure of relaxation strength. A lesser amount of data for 10-hr relaxation strengths is also given. The temperatures covered mainly range from 750 to 1100 F with data at 1200 to 1500 F for super-strength alloys. Tabulated data also include chemical composition, heat treatment, mechanical properties at room temperature, and limited creep data.

***Price to ASME members**

MANUAL ON CUTTING OF METALS WITH SINGLE POINT TOOLS

Published 1953. $10.00—This book contains shop-tested data on the machining of high nickel alloys, stainless steels, copper and brass alloys, magnesium, cast irons and plastics. It offers valuable information on the structure of the metals to be machined; the correct tool material, size and shape of cut, and the proper cutting fluid. It shows how to predetermine the power requirements and best operating speed for all jobs. It helps time study men to set standards of practice and cost of production, and it provides 322 tables of cutting speeds and horsepower for various feeds and depths of cut when turning commonly used steels and cast iron.

STRUCTURES FOR THERMAL FLIGHT

Published 1956. $3.00—The problem areas herein covered are materials at elevated temperatures, optimum airframe structures, factor of safety concepts, and elevated temperature testing techniques. CONTENTS: Challenge of Progress. High Speeds Problems of Large Airplanes. Aluminum Alloys for Elevated Temperature Service. Application of a New Structural Index to Compare Titanium Alloys with Other Materials in Airframe Structures. Optimum Streses of Structural Elements at Elevated Temperatures. Thermostructural Efficiencies of Compression Elements, and Materials. Weight Efficiency Analysis of Thin Wing Construction. Design Criteria for Heated Aircraft Structures. Some Structural Penalties Associated with Thermal Flight. Aircraft Structural Testing Techniques at Elevated Temperatures. Some NACA Research on the Effect of Transcient Heating on Aircraft Structures. Utilization of Solar Furnaces in High Temperature Research.

VISCOSITY OF LUBRICANTS UNDER PRESSURE

Published 1954. $5.00—This publication reviews and coordinates twelve experimental investigations made over a period of thirty-five years, on 148 lubricants comprising of 25 fatty oils, 94 petroleum oils, 17 compounded oils and 12 other lubricants. Data are coordinated by means of sixty tables in which the results originally appearing in diversified units are compared. The methods proposed for correlating viscosity-pressure characteristics of oils with properties determined at atmospheric pressures are reviewed and illustrated. Experimental work on heavily loaded bearings, lubrication calculations, and additional techniques for viscosity are covered. Conclusions and recommendations are presented. Computation of the temperature coefficients of viscosity and the method of computing pressure coefficients are also given.

PROPERTIES OF STEAM AT HIGH PRESSURES

Published 1956. $1.00—This is an interim steam table covering a range from 5500 to 10,000 psi and 32 to 1600 degrees F. It is published to provide a reasonable extrapolation of the current tables that will be useful in power systems calculations until an authoritative steam table has been published—five years hence.

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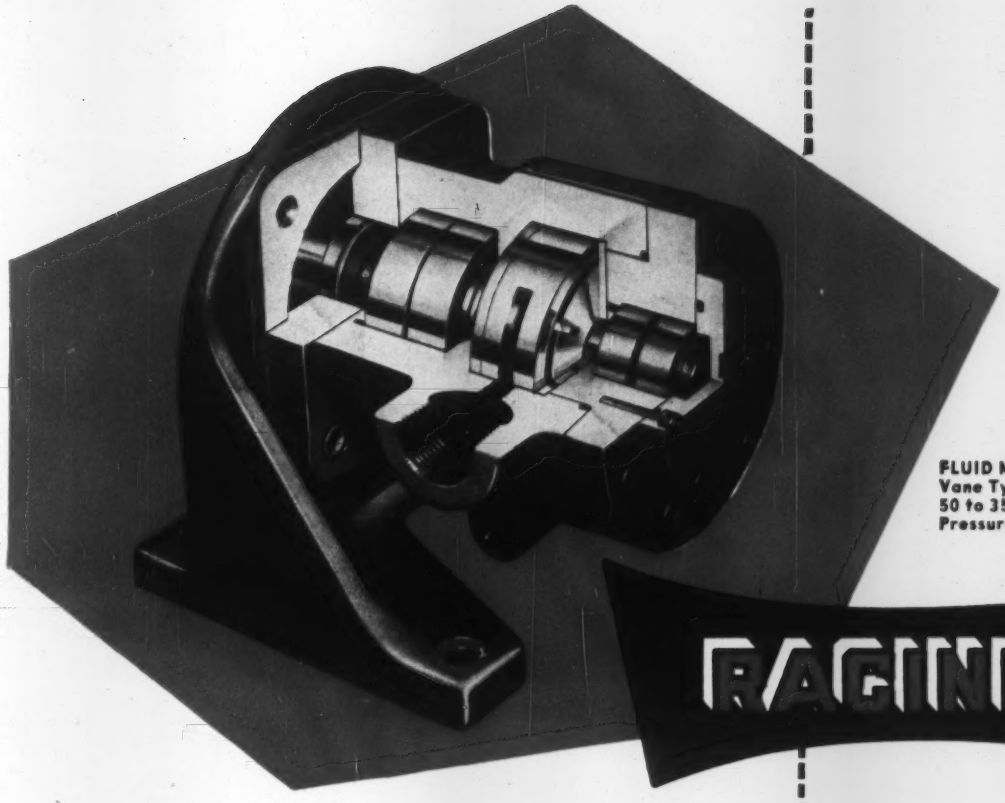

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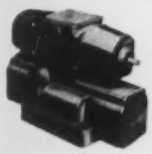

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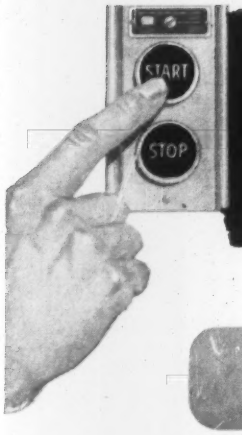

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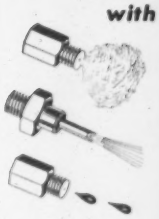
ALEMITE OIL-MIST AUTOMATIC LUBRICATION

provides constant, uniform, foolproof lubrication— at savings up to 90%!

Alemite Oil-Mist *atomizes* oil into tiny, airborne particles that are distributed to bearings through tubing. It bathes all bearings with a cool film of clean oil . . . maintains uniform oil film regardless of variations in loads, temperature and speed. Simple, continuous, fully automatic. Eliminates the waste and uncertainties of the "human element" in lubrication. Uses up to *90% less lubricant* than ordinary lubrication methods!

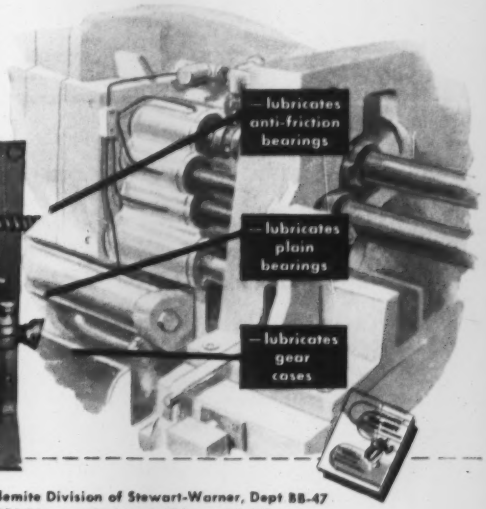
Lubricates any bearing on any machine with one of three types of fittings:



Mist fittings for roller, ball, needle—or any anti-friction type of bearings.

Spray fittings for open and enclosed gears and chains.

Condensing fittings for plain bearings, slides, ways, vees, cams, and rollers.



8 Advantages of the Alemite Oil-Mist System

1. Continuous lubrication. Deposits fresh, clean film of oil on all surfaces of all bearings.

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3. No guesswork. Bearings can't be overlooked, or over-lubricated!

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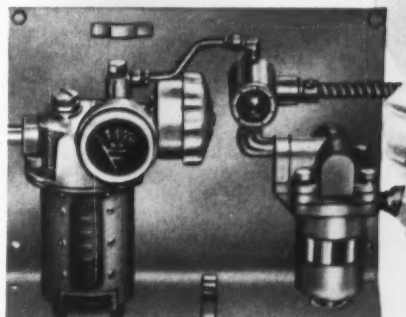

8. As high as 90% less oil consumption. Usually consumes about 1/10th amount used by any other oiling method.

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A Multipress case study

Multipress, used here for staking chromium-plated pepper mill lids, saves 11¢ per unit for specialty manufacturer.

MULTIPRESS® saves specialty manufacturer 11¢ per unit

By using a Denison hydraulic Multipress equipped with simple interchangeable tooling, The George S. Thompson Corporation, South Pasadena, California, manufacturer of the Olde Thompson line of pepper mills and gourmet accessories, is now saving 11¢ on each pepper mill produced.

Previous methods for three sub-assembly operations cost the company 15¢ per unit. With the hydraulic Multipress, costs for these three operations have been reduced to 4¢ per unit. In addition to this significant cash savings, rejects have been virtually eliminated and production has been substantially increased.

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Write for Datalog ASY-5 describing this money-saving method.

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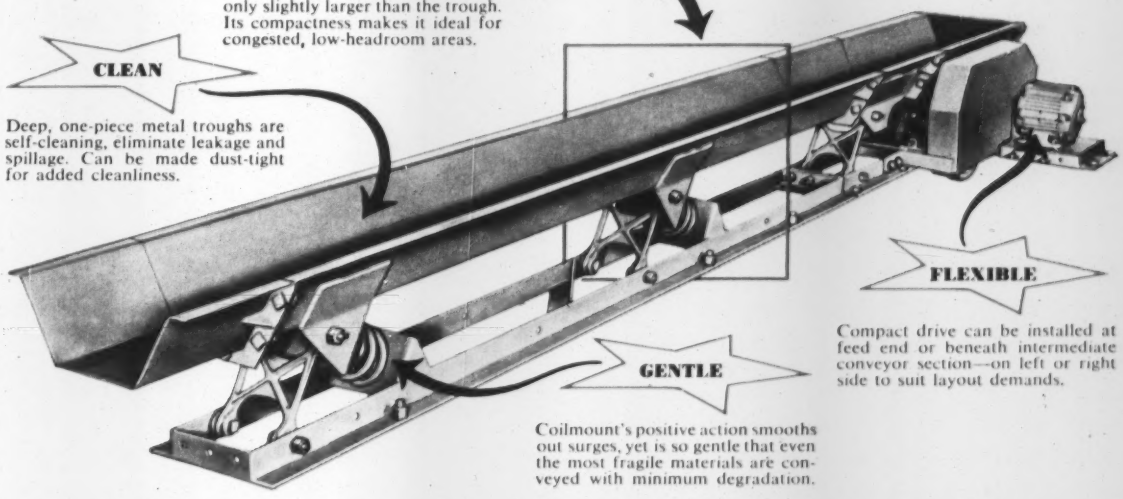
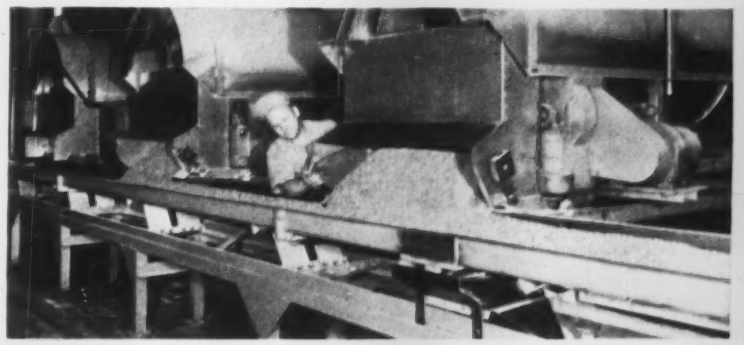

COMPACT
Coilmount requires an opening only slightly larger than the trough. Its compactness makes it ideal for congested, low-headroom areas.
CLEAN
Deep, one-piece metal troughs are self-cleaning, eliminate leakage and spillage. Can be made dust-tight for added cleanliness.
FLEXIBLE
Compact drive can be installed at feed end or beneath intermediate conveyor section—on left or right side to suit layout demands.
GENTLE
Coilmount's positive action smooths out surges, yet is so gentle that even the most fragile materials are conveyed with minimum degradation.

LINK-BELT's positive action and natural frequency principles prevent dampening . . even under surge loads

THE many advanced features of the new Link-Belt Coilmount oscillating conveyor make it ideal for low-cost, medium-duty applications—materials ranging from powder to lumps as wide as the conveyor trough. Combining economies of *natural frequency* with dependable *positive action*, its gentle oscillation smooths out surges for uniform, continuous feed.

Compact, pre-assembled sections simplify installation . . . reduce cost. Trough can be adapted for screening, drying, cooling or other processing operations. For facts, call your nearby Link-Belt office or authorized stock-carrying distributor. Or write for Books 2444 and 2644.



LIGHT-CAPACITY FLEXMOUNT provides uniform conveying for a wide range of materials. Compact conveyor is available from stock in 8-, 12- and 18-in. trough widths, with capacities up to 24 tph.

Book 2444 Book 2644

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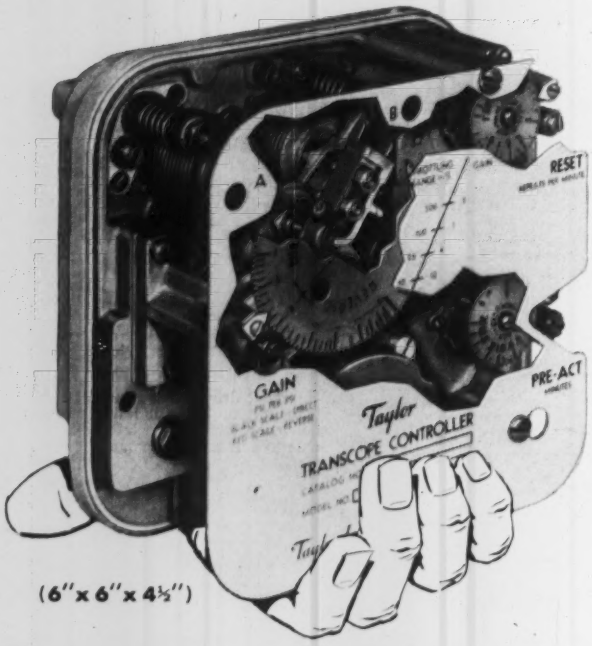

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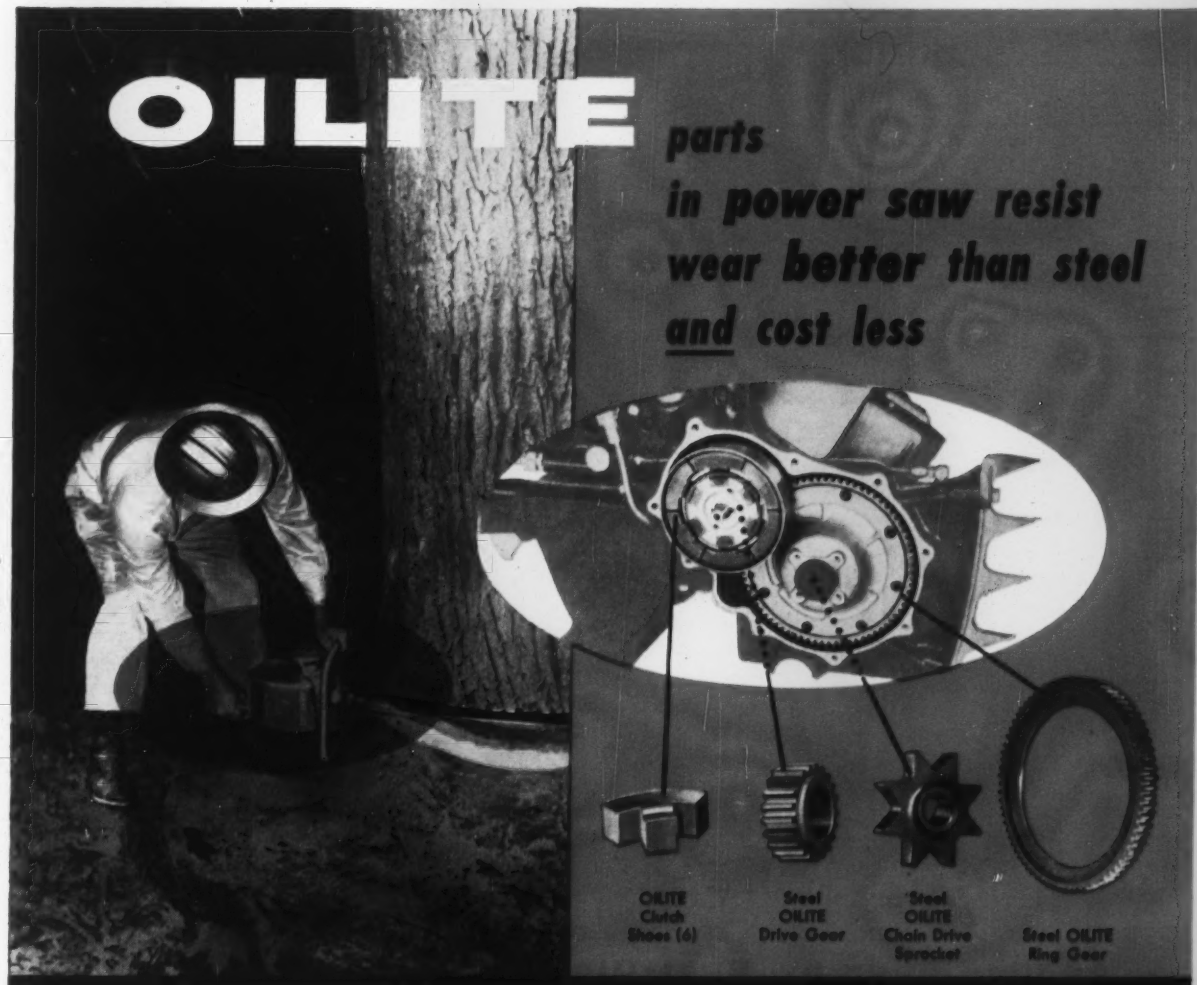

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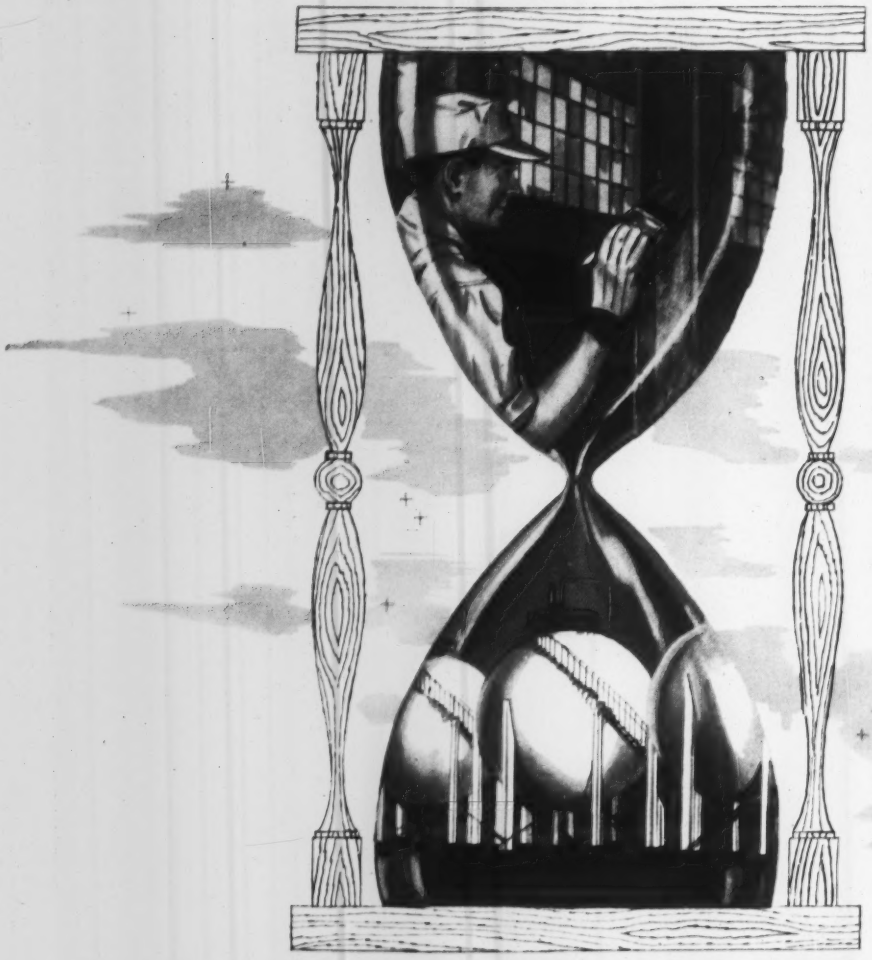

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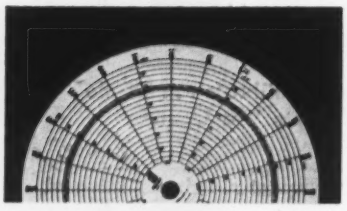
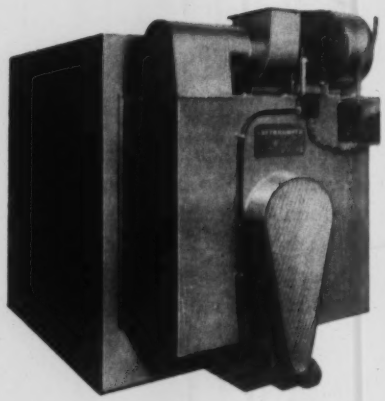


This is a true story—happened in a candy factory in Chicago. But it's one that's been repeated hundreds of times all over the world—in every type of plant where unwanted moisture is present in air, gases or organic liquids.



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If you're tired of seeing high humidity gum up your production, send for the booklet *Because Moisture Isn't Pink.* It tells how other weather watchers solved their moisture problems. Write Pittsburgh Lectrodryer Division, McGraw-Edison Company, 335 32nd Street, Pittsburgh 30, Pennsylvania.

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This Ell Bolt is the Key to leak control

The patented Ell Bolt construction employed on Vogt floating head heat exchangers is the answer to re-assembly without distortion or leak development.

Cover may be removed by simply loosening the Ell Bolt nuts and disengaging the Ell Bolt heads from the "lock notches." No misplacing of Ell Bolts can result — and tightening is easy and positive — absolutely leak proof. Send for Bulletin HE-6. Address Dept. 24A-XM.

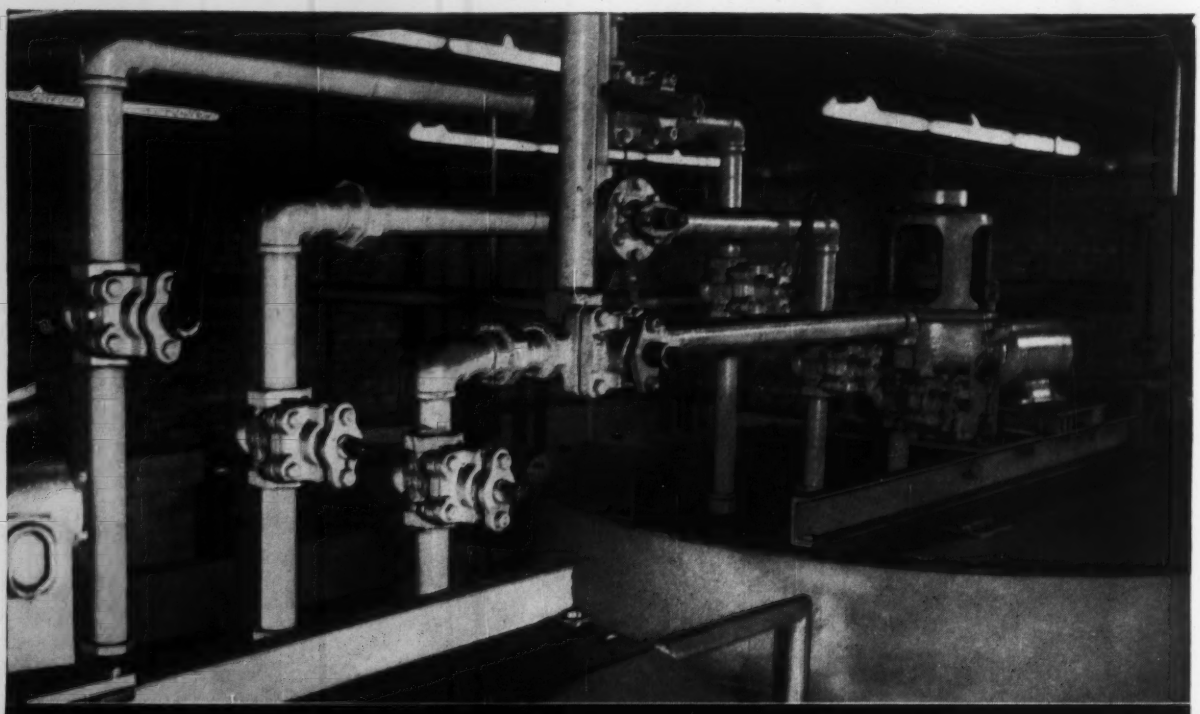
HENRY VOGT MACHINE CO., P. O. BOX 1918, LOUISVILLE 1, KY.

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Philadelphia, St. Louis, Charleston, W. Va., Cincinnati

Vogt

OTHER VOGT PRODUCTS
Drop Forged Steel Valves, Fittings and Flanges in a complete range of sizes • Petroleum Refinery and Chemical Plant Equipment • Steam Generators • Heat Exchangers • Ice Making and Refrigerating Equipment.

HEAT TRANSFER EQUIPMENT



Aqueous and Lacquer-Type Coatings . . . Duplicating Inks . . . Condensate . . . Hot Water are handled by

HOMESTEAD *Cam-Seald* PLUG VALVES

AT A. B. DICK COMPANY, CHICAGO

Positive, drop-tight seal without lubrication . . . quick operation; only a quarter-turn to open or close . . . sealed bottom, and stuffing box that prevent leakage . . . seating surfaces that are protected in both the open and closed positions for extra long life—these are some of many features that influenced the choice of Homestead Cam-Seald Valves for this modern plant. The more than 5,000 Homestead Valves of various types, in service at A. B. Dick Company's Chicago, Illinois Plant were chosen only after an analysis of numerous types of valves showed that "HOMESTEAD'S" were well suited for the service conditions.

You can prove to your own satisfaction that HOMESTEAD PLUG VALVES give long, dependable drop-tight service with low upkeep, by installing a few in your plant. Full particulars are yours without obligation.

MAIL THE COUPON TODAY ➤

Please mail, without obligation,
Valve Reference Book
No. 39—Section 2.

Name_____ Title_____

Company_____

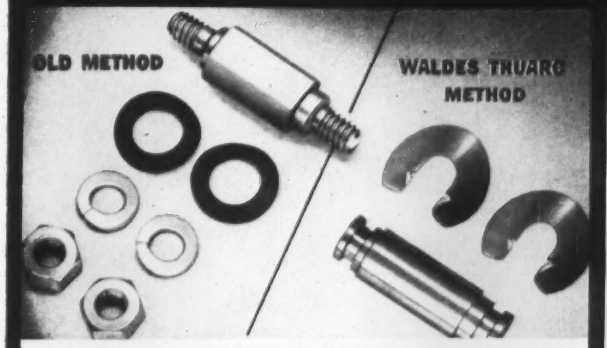
Address_____

City_____ State_____

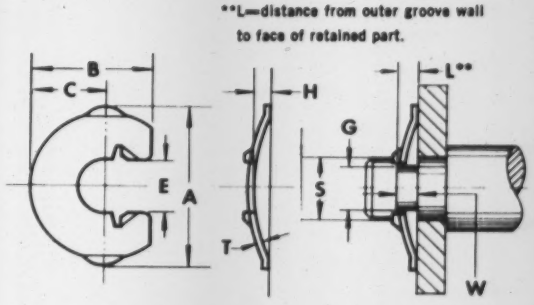
HOMESTEAD VALVE MANUFACTURING COMPANY

P. O. BOX 38 *"Serving Since 1892"* CORAOPOLIS, PA.

New Waldes Truarc locking-prong ring functions as spring, shoulder, fastener... and STAYS PUT!



Above assembly shows how 2 Waldes Truarc Locking-Prong Rings (Series 5139) replaced 6 parts... eliminated threading operation... and need for skilled labor.



WALDES TRUARC LOCKING-PRONG RING (Series 5139)
U. S. Pat. Pending

Ring No. 5139-	SHAFT Dia. S	tol.	RING DIMENSIONS A	tol.	B	tol.	C	tol.	E	tol.	H	tol.	T†	tol.†	average ultimate shear strength lbs.*	GROOVE DIMENSIONS Dia. G	tol.	Width W	tol. — .000	L min.	L max.	resilient end play take up L max — L min
12	.125	±.002	.340	±.010	.307	±.010	.166	±.005	.086	±.004	.050	±.010	.010	±.0013	400	.082	±.0015	.045	+.005	.035	.045	.010
★15	.156	±.003	.380	±.010	.330	±.010	.184	±.005	.108	±.004	.055	±.010	.010	±.0013	600	.104	±.002	.050	+.005	.035	.045	.010
18	.188	±.003	.445	±.010	.390	±.010	.213	±.005	.130	±.005	.060	±.010	.015	±.0015	900	.124	±.002	.065	+.005	.045	.055	.010
25	.250	±.003	.581	±.010	.500	±.010	.280	±.005	.172	±.005	.070	±.010	.015	±.0015	1000	.165	±.002	.070	+.005	.050	.065	.015
31	.312	±.003	.744	±.010	.620	±.010	.360	±.005	.234	±.005	.095	±.010	.018	+.001 −.002	1300	.228	±.003	.080	+.005	.080	.095	.015
★37	.375	±.003	.853	±.015	.740	±.010	.427	±.005	.280	±.005	.130	±.010	.020	±.002	1900	.270	±.003	.105	+.005	.090	.115	.025
★43	.438	±.003	.960	±.020	.820	±.020	.475	±.010	.337	±.010	.130	±.010	.020	±.002	2200	.327	±.003	.105	+.005	.095	.120	.025

Additional Sizes Under Development ★Production dies not available as of date of printing †Applies to unplated rings only *Recommended safety factor —3 to 4.

The Waldes Truarc Locking-Prong Retaining Ring is a new, low cost, radially applied fastener which can be locked positively in its groove and used as a shoulder against rotating parts. It is primarily intended for use in the automotive, electronic and aeronautical industries.

This radially applied ring locks positively in its grooves by means of two prongs at the open end. Because of its high thrust-load capacity the Waldes Truarc Locking-Prong Ring may be used as a shoulder against rotating parts. Its bowed construction provides for end-play take-up in the assembly and makes less critical the tolerances required for the parts being fastened. Since it serves as a spring as well as a shoulder, this ring eliminates the need for springs, washers, and other accessory fastening devices.

Whatever you make, there's a Waldes Truarc Retaining Ring designed to improve your product... to save you material, machining and labor costs. They're quick and easy to assemble and disassemble, and they do a better job of holding parts together. Truarc rings are precision engineered and precision made, quality controlled from raw material to finished ring.

36 functionally different types... as many as 97 different sizes within a type... 5 metal specifications and 14 different finishes. Truarc rings are available from 90 stocking points throughout the U. S. A. and Canada.

More than 30 engineering-minded factory representatives and 700 field men are available to you on call. Send us your blueprints today... let our Truarc engineers help you solve design, assembly and production problems... without obligation.

SEND FOR FREE SAMPLES

WALDES TRUARC® RETAINING RINGS

Waldes Kohinoor, Inc., 47-16 Austel Place, L.I.C. 1, N.Y.

☐ Please send me sample Locking-Prong Rings. (please specify shaft size_____)

☐ Please send me supplement No. 1 which brings Truarc Catalog RR 9-52 up to date.

(Please print)

Name.....

Title.....

Company.....

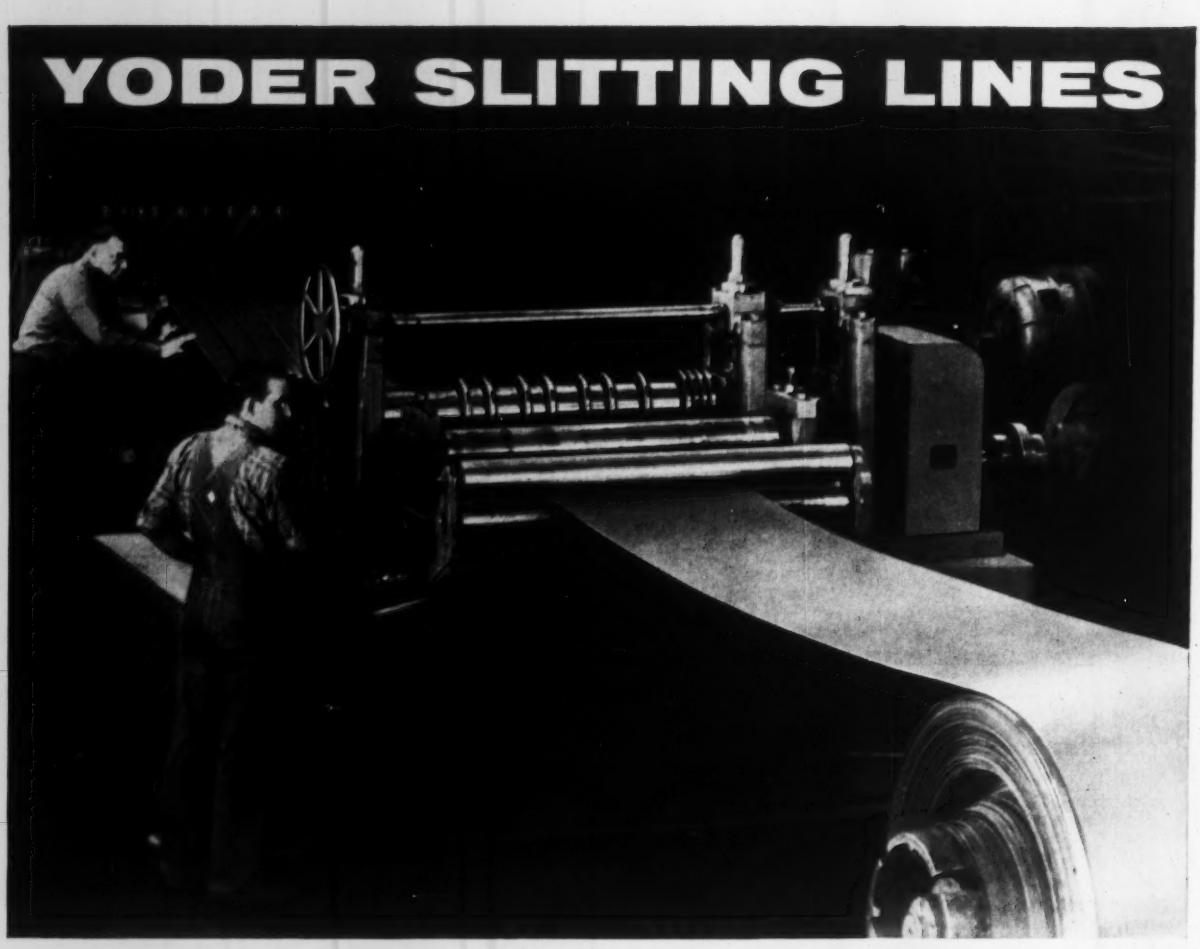
Business Address.....

City..... Zone..... State.....

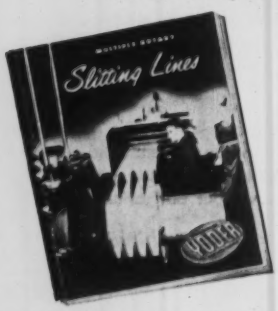
ME 949

WALDES TRUARC Retaining Rings, Grooving Tools, Pliers, Applicators and Dispensers are protected by one or more of the following U. S. Patents: 2,382,948; 2,411,426; 2,411,761; 2,416,852; 2,420,921; 2,428,341; 2,439,785; 2,441,846; 2,455,165; 2,483,379; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,491,310; 2,509,081; 2,544,631; 2,546,616; 2,547,263; 2,558,704; 2,574,034; 2,577,319; 2,595,787. and other U. S. Patents pending. Equal patent protection established in foreign countries.

YODER SLITTING LINES



pay big dividends working only one day per week!



The Yoder Slitter Book **is a comprehensive treatise on slitter operation and economics, with time studies, cost analyses and other useful data. It is yours for the asking.**

In one plant, two Yoder tube mills and about 50 punch presses are being supplied with slit strands by one Yoder Slitting Line operated an average of only *seven hours per week.*

In another plant, a Yoder slitting line, *operated from six to eight hours per week,* is supplying two intermittently operated roll forming machines with total requirements averaging 100,000 feet per week.

These typical examples demonstrate, first, the big potential output of a relatively small, inexpensive Yoder standardized Slitting Line and, secondly, its big profitability. Assume production of only 35 tons of slit strands per 8 hour shift, one day per week, and the total per year would be 1750 tons. Estimating the saving in slitting cost at only one-half cent per lb., the total annual saving would be $17,500.00.

Besides the big convenience of doing your own slitting, such savings will often repay the investment in a few months.

THE YODER COMPANY 5499 Walworth Avenue • Cleveland 2, Ohio, U.S.A.

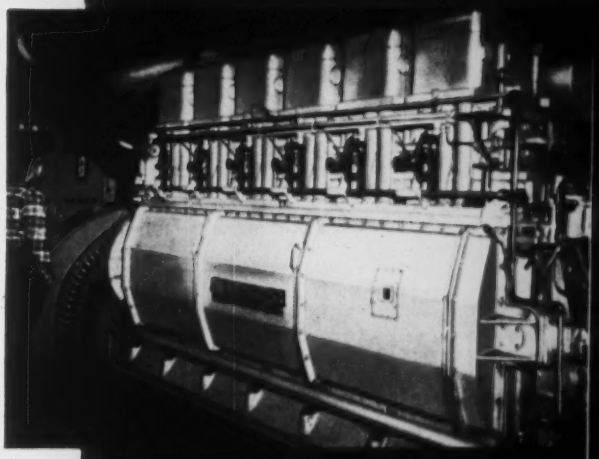
ENGINEERING YODER MANUFACTURING

ROTARY SLITTING LINES

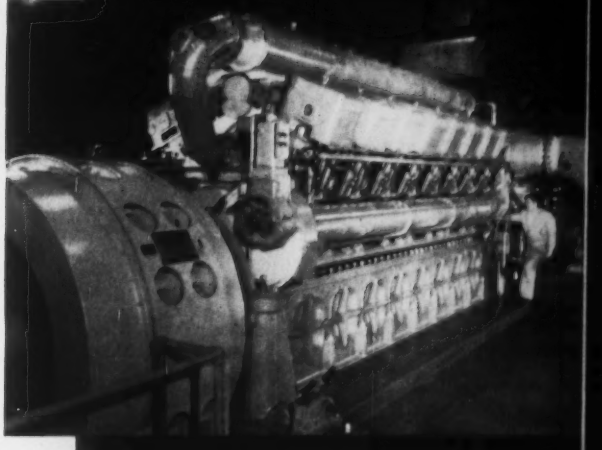
COLD ROLL FORMING MACHINES

ELECTRIC-WELD PIPE AND TUBE MILLS

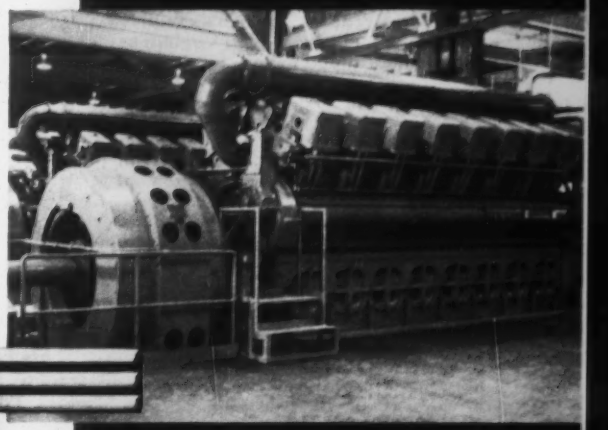
3 WAYS TO CUT POWER COSTS WITH NORDBERG ENGINES



1 ***For standby service*** . . . this 1200 hp, 840 kw Nordberg *Supairthermal*® Diesel Generator is serving a Midwestern Utility Company.



2 ***For peak load service*** . . . this is one of three Nordberg *Supairthermal* Diesel generator units, ranging from 1150 kw to 2285 kw, now serving a Southern Utility Company.



3 ***For boosting voltage*** . . . these are two 3500 hp, 2500 kw Nordberg Diesel Generator units serving an Eastern Utility Company.

These three typical installations show some of the ways that utilities are now utilizing Nordberg engines to increase the operating flexibility of their existing facilities and to add valuable standby protection on a financially sound, profitable basis.

Built in sizes from 10 to over 12,000 horsepower, including Diesel, Duafuel® and Spark-Ignition Gas types, Nordberg engines are easily installed, go on the line quickly and provide low cost power generation under all load conditions.

Let experienced Nordberg engineers help solve your specific power problem.
Write for further information.

NORDBERG MFG. CO., Milwaukee, Wisconsin

BUILDERS OF AMERICA'S LARGEST LINE OF HEAVY DUTY ENGINES . . . 10 to over 12,000 HORSEPOWER

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P-556

NORDBERG

DIESEL • DUAFUEL® AND SPARK IGNITION GAS ENGINES

INCREASED PRODUCTION *with* GREATER FUEL ECONOMY

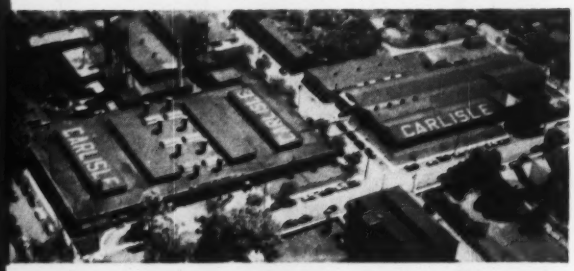
Smokeless Operation

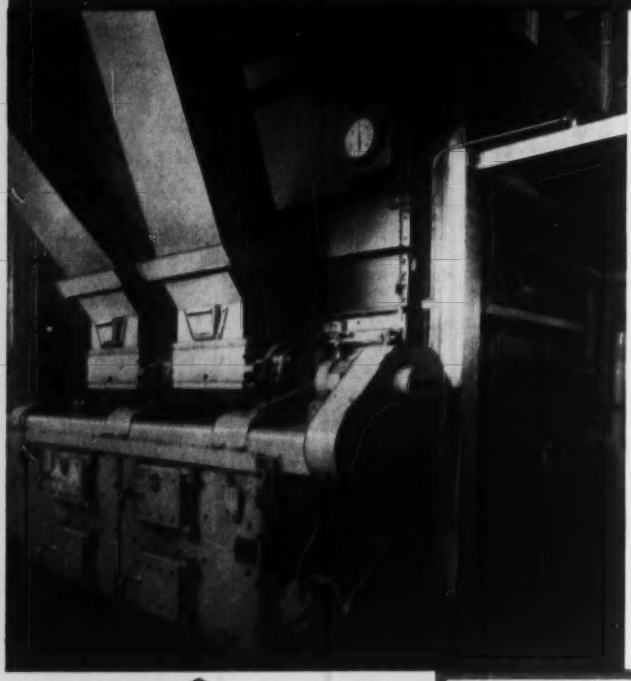
DETROIT ROTOSTOKER TYPE C-C

(Continuous Cleaning)

at Carlisle Tire and Rubber Division

CARLISLE, PA.





It is not uncommon for the Detroit RotoStoker, Type C-C to make fuel savings ranging from 10% to 25%. Where process steam is used in production, as in this plant, fuel economy is usually accompanied by a substantial production increase.

In addition the Type C-C provides smokeless operation at light loads as well as at full capacity—important in built-up areas.

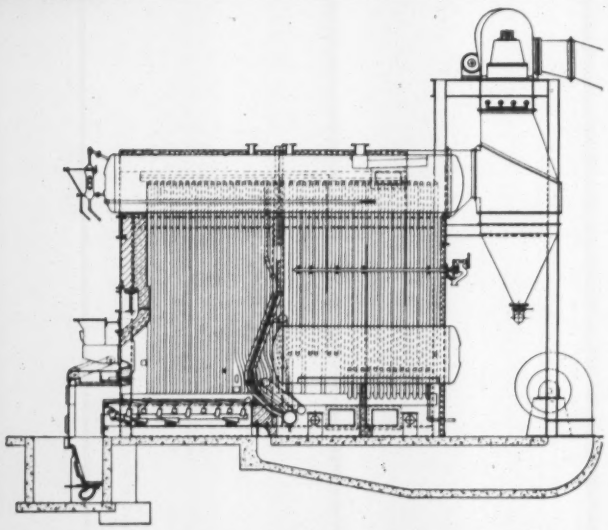
Other advantages of Type C-C are:

- **Continuous uninterrupted steaming.**
- **Ample capacity and high availability.**
- **Quick response to load fluctuations.**
- **Fuel feeders and distributors handle high moisture coals without clogging.**
- **Available to develop 5,000 to 75,000 lbs. of steam per hour.**
- **Easily applied to new or existing boilers.**
- **Low Maintenance.**

Detroit RotoStoker Type C-C (continuous cleaning) in the plant of Carlisle Tire and Rubber Division of Carlisle Corporation. This unit has a capacity of 25,000 pounds of steam per hour. Either West Virginia or Pennsylvania 13,500 BTU coal is used.

•

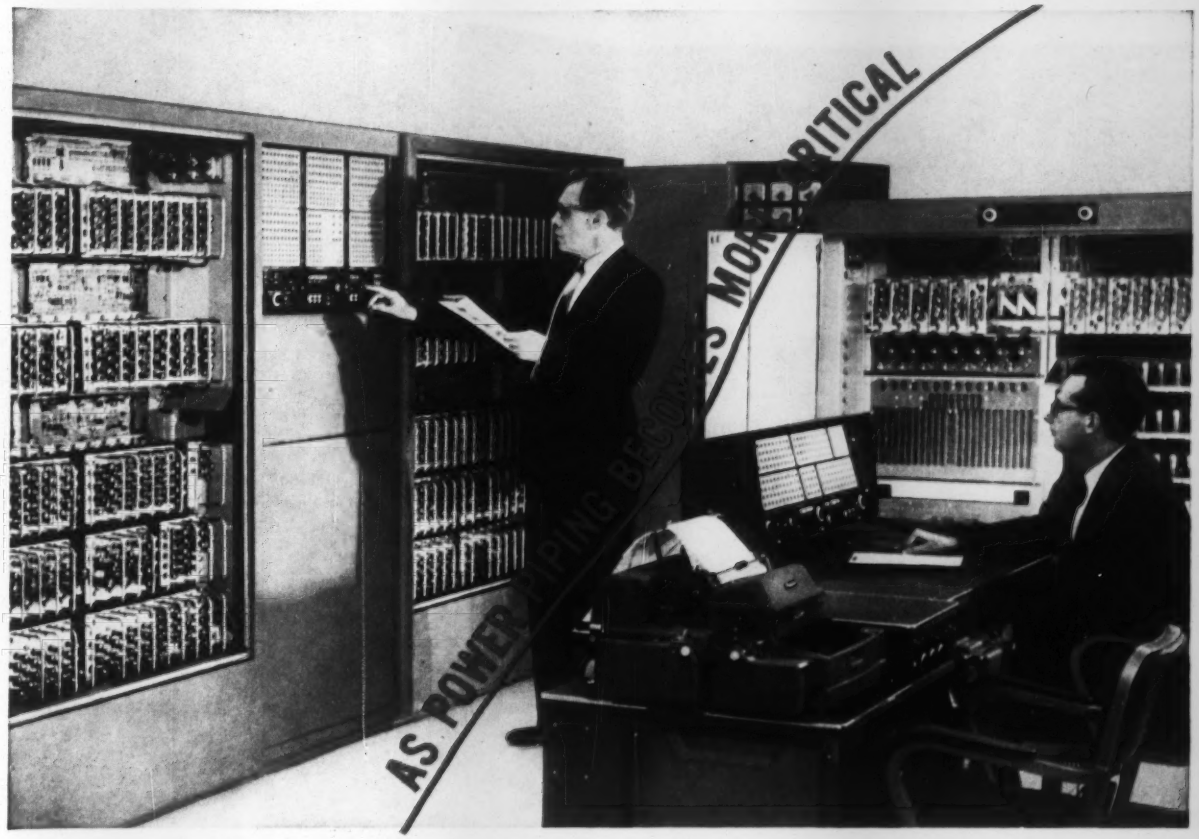
Keeler Type CP Boiler with Detroit RotoStoker Type C-C. Ashes discharge at front, are removed by a conveyor. No basement is needed.



DETROIT STOKER COMPANY

MAIN OFFICE AND WORKS
DETROIT, MICHIGAN

Branch Offices and Representatives



Kellogg's Design Calculation Techniques Keep Pace

Latest and most valuable electronic addition to The M. W. Kellogg Company's facilities for solving the design calculation problems of power piping customers is a new, large magnetic drum digital computer. It can execute 500 arithmetical operations per second; conservatively can solve 40 simultaneous equations in 30 minutes; and has a memory capacity of over 4000 ten-digit words. This computer is now in use at Kellogg's new New York Headquarters, and supplements a smaller computer which has been employed for some time at M. W. Kellogg's Jersey City laboratories.

This new computer enables The M. W. Kellogg Company's engineering staff to undertake a far greater number of precise calculations in less time than ever before and, as a result, to determine the optimum main and reheat steam piping designs for steam-electric power plants in minimum time.

A cordial invitation to see the new Datatron computer at work is extended to consulting engineers, and to engineers of power generating companies and their equipment manufacturers. Appointments may be made by contacting the office of the Sales Manager, Fabricated Products Division, The M. W. Kellogg Company, 711 Third Avenue, New York 17, N. Y.

FABRICATED PRODUCTS DIVISION

THE M. W. KELLOGG COMPANY, 711 THIRD AVE., NEW YORK 17, N. Y.

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POWER PIPING—THE VITAL LINK

Does your **Cylindrical** *problem call for a* **Centrifugal** *solution?*

If your product plans call for hollow cylindrical parts, give some thought to these facts. Manufacturers who had never seriously considered cast parts before are discovering important advantages in Sandusky centrifugal castings.

They're getting exceptional resistance to heat, corrosion, abrasion and stress, through the use of special alloys cast centrifugally . . . in diameters from 7" to 54", and lengths to 33 feet depending on diameter . . . and specially machined to specifications.

How can our versatile staff and facilities help you? Tell us your product requirements. Let us explore your ideas. Perhaps we can help solve your cylindrical problems through the vast foundry experience, metallurgical research and machining skills our 46 years offer.

Your request will bring more information promptly . . . or, if you prefer, a personal call by one of our engineers. Sandusky Foundry and Machine Company—Sandusky, Ohio.

Sandusky centrifugal castings offer you 4 important advantages:

1. ***SUPERIOR STRENGTH***—through non-directional mechanical properties
2. ***BETTER QUALITY***—machined castings are porosity-free
3. ***UNIFORM SOUNDNESS***—harmful inclusions are forced out by spinning motion
4. ***JOB-READY FINISHED CASTING***—reach you machined exactly to your specifications . . . eliminating extra costs from rejects, down-time, loss of production, etc.

Sandusky Centrifugal Castings

Stainless steels—plain carbon and low alloy steels—wide variety of copper base compositions

NEW EXPANSION JOINT DESIGN

from the world's most experienced manufacturer

Up to 50% Less Weight...
Longer Cyclic Life...
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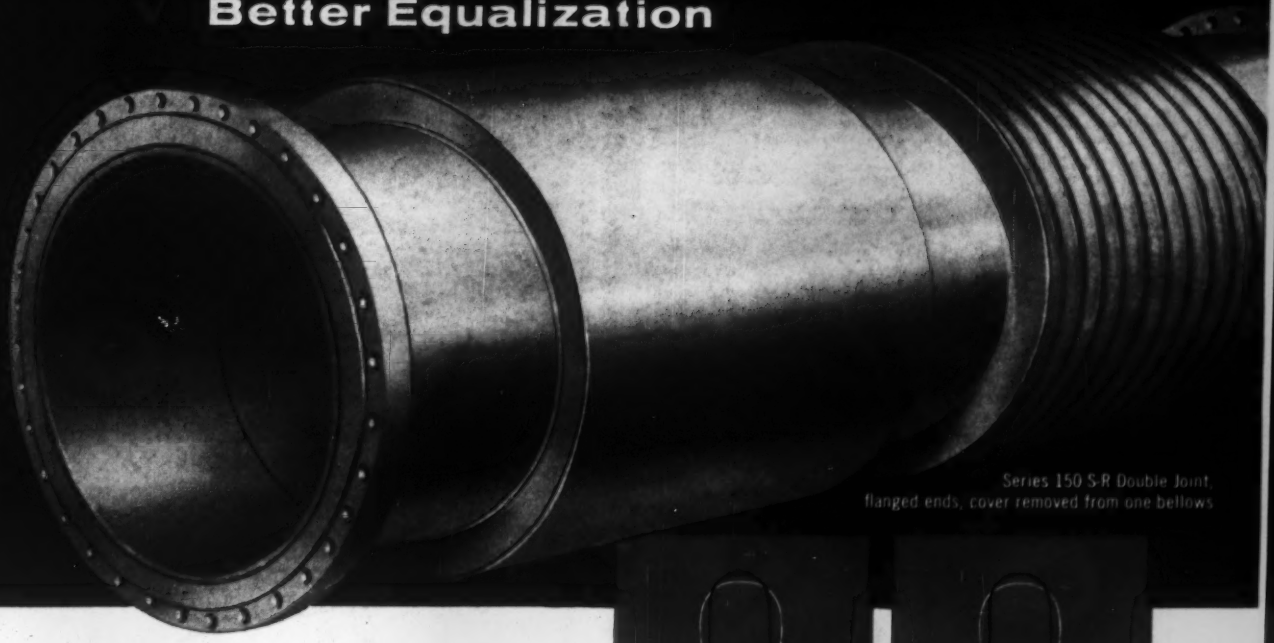

Series 150 S-R Double Joint, flanged ends, cover removed from one bellows

Intensive research program pays off in revolutionary design of Badger S-R Expansion Joints

BADGER S-R Packless Corrugated Expansion Joints — an entirely new design — are now ready for your most exacting power, heating, industrial and process piping applications.

Two significant features of Badger S-R Joints are 1.) Curvilinear Corrugations, which result in natural "all-curve" flexing and more equal distribution of movement among the corrugations; 2.) tubular Reinforcing Rings, which work with the new corrugations to produce greater effective flexing height and "all-curve" flexing even under higher pressures and temperatures.

And there are other important features, too . . . size for size, Badger S-R Joints weigh up to 50% less than conventional types . . . new ring design reduces joint diameter . . . a complete line of accessories — including covers and liners — are available . . . standard models in stainless, monel and inconel, special types in any workable alloy.

Write for illustrated brochure today!

Series 50 corrugation cross-section

Series 150 corrugation and ring cross-section

New corrugation and ring designs produce better equalization, "all-curve" flexing.

The radically different Curvilinear Corrugations used in Badger Series 50 S-R Expansion Joints were developed by the Badger Research Department. When under operating pressure (white line in cross-section above), the new design produces more uniform movement per corrugation and natural "all-curve" flexing. These features result in lower stresses and therefore increased life.

Series 150 S-R Joints also feature Curvilinear Corrugations and, because they are used at higher pressures, have tubular Reinforcing Rings. These new rings make metal-to-metal contact only in the "valley" of each corrugation yet allow natural "all-curve" flexing (white line). The tubular shape of the rings also permits greater effective flexing height and therefore contributes to longer joint life.

BADGER

S R

SERVICE RATED

EXPANSION JOINTS

BADGER MANUFACTURING COMPANY • *230 Bent St., Cambridge 41, Mass.* • *60 East 42nd Street, N. Y., N. Y.*

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"MONOBALL"®
Self-Aligning Bearings

CHARACTERISTICS

	ANALYSIS	RECOMMENDED USE
1	Stainless Steel Ball and Race	For types operating under high temperature (800-1200 degrees F.).
2	Chrome Alloy Steel Ball and Race	For types operating under high radial ultimate loads (3000-893,000 lbs.).
3	Bronze Race and Chrome Moly Steel Ball	For types operating under normal loads with minimum friction requirements.

Thousands in use. Backed by years of service life. Wide variety of Plain Types in bore sizes 3/16" to 6" Dia. Rod end types in similar size range with externally or internally threaded shanks. Our Engineers welcome an opportunity of studying individual requirements and prescribing a type or types which will serve under your demanding conditions. Southwest can design special types to fit individual specifications. As a result of thorough study of different operating conditions, various steel alloys have been used to meet specific needs. Write for revised Engineering Manual describing complete line. Dept. Me-57.

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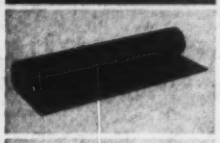
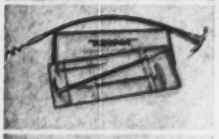
RHOPAC Top Quality

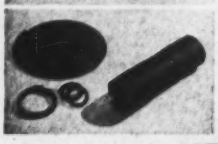
Gaskets and Tapes. Making gaskets and tapes from top quality Asbestos Wire Inserted Cloth is a Rhopac specialty. Specify Rhopac boiler gaskets, folded tapes (plain or tadpole), and retort door packing. Prompt service — low prices.



Sheet Gasket Materials. All standard gasket materials in various thicknesses kept in stock at all times — available in sheet or roll form. Your order will receive immediate attention.



Rhopac Packing Hooks. A packing extractor whose flexible shaft greatly simplifies the removing of old, worn-out packing. In set of 3 handy sizes — other sizes available. A great time and labor saver.



Mechanical Packings. We stock a wide selection of high temperature, high pressure and all standard types of packing. Special requirements are also developed and produced on short notice.

See Rhopac on All Gasket and Packing Problems

Exceptional Service — Top Quality

Rhopac, Inc.
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Manufacturers of mechanical packings, industrial and boiler gaskets, steel rule dies, flexible packing hooks

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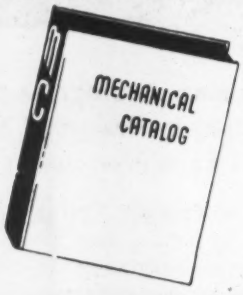
WORK FOR YOUR COMPANY?



MAY 1—CLOSING DATE FOR FREE PRODUCT LISTING FORM SENT TO YOUR COMPANY

Be sure your company takes advantage of the FREE LISTINGS in the directory section of the 1958 MECHANICAL CATALOG

The editors of Mechanical Catalog are expanding and improving the directory section to make it of even greater service to you ... of even greater value to manufacturers of products used and bought by mechanical engineers in industry.

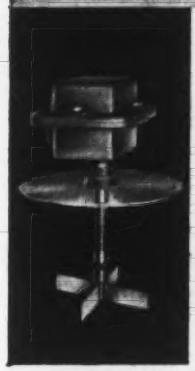
Listing guides have been sent to over 3,500 companies to enable them to conveniently check off products they wish listed in this valuable reference book. Your company has received one of the guides. If it has not been returned to us, you'll do your company and the Society a great favor by expediting its return. If your company has not received a free product listing guide, drop us a line and we'll forward one immediately. By all means, be sure your company's products are listed in the directory section of the 1958 MC.

Published annually as a service to members by

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

29 West 39th Street, New York 18, N. Y.

NEW BIN LEVEL INDICATOR



New ROTO-BIN-DICATOR®

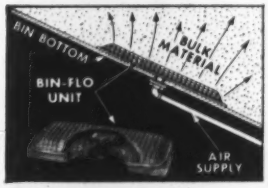
Motor driven paddle-type bin level indicator

For automatic bin level indication or control of bulk materials. Particularly suited to applications on bins subject to pressure or vacuum.

EXPLOSION-PROOF
U. L. listed units available

BIN-DICATOR®

The original diaphragm-type bin level indicator. In successful use for 20 years.



BIN-FLO®

Assures gravity flow of pulverized materials

Bin-Flo Aerator units in bins, chutes, etc., use small volume, low pressure air to restore flow to dry, pulverized materials which tend to pack and bridge in storage.

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13946-W Kercheval • Detroit 15, Mich.

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MECHANICAL ENGINEERING
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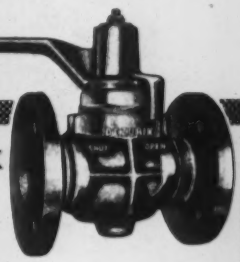

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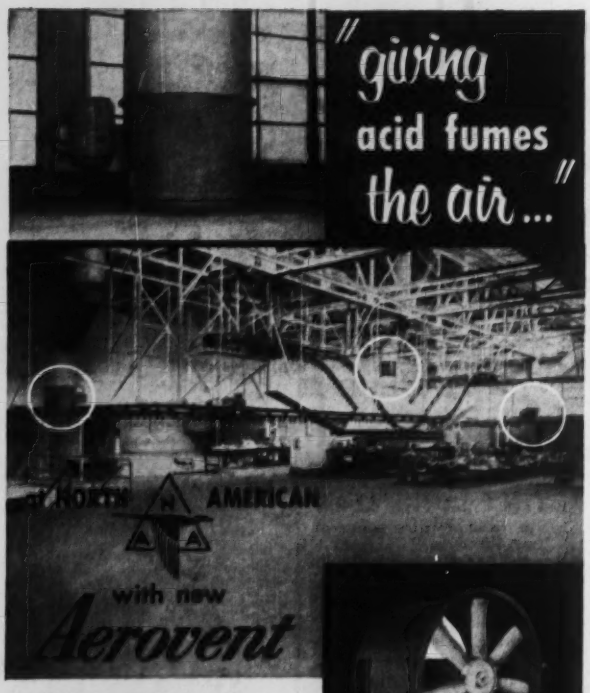

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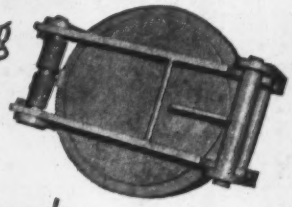

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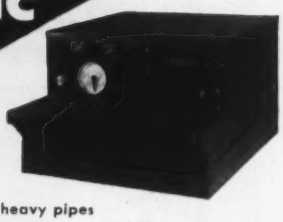

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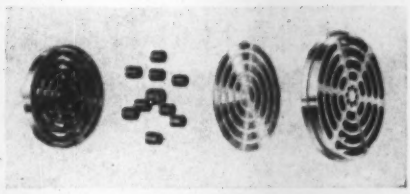

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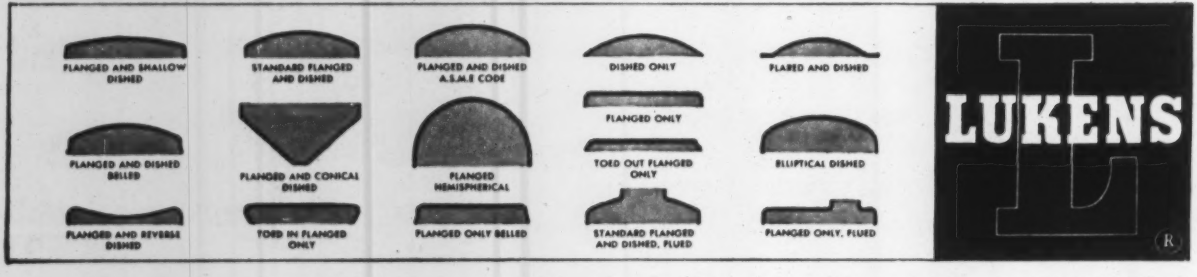

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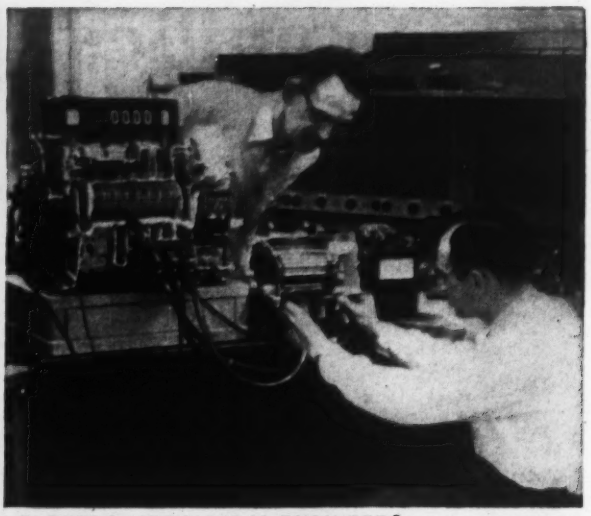

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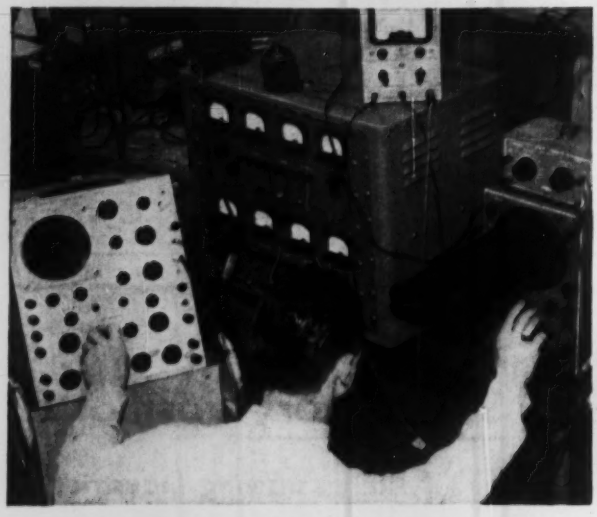

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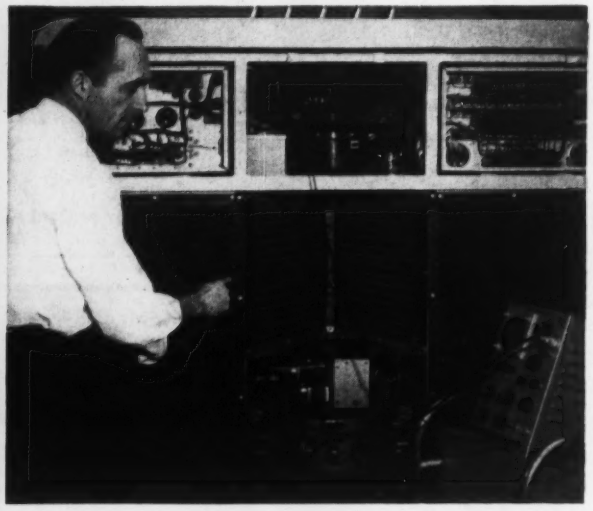

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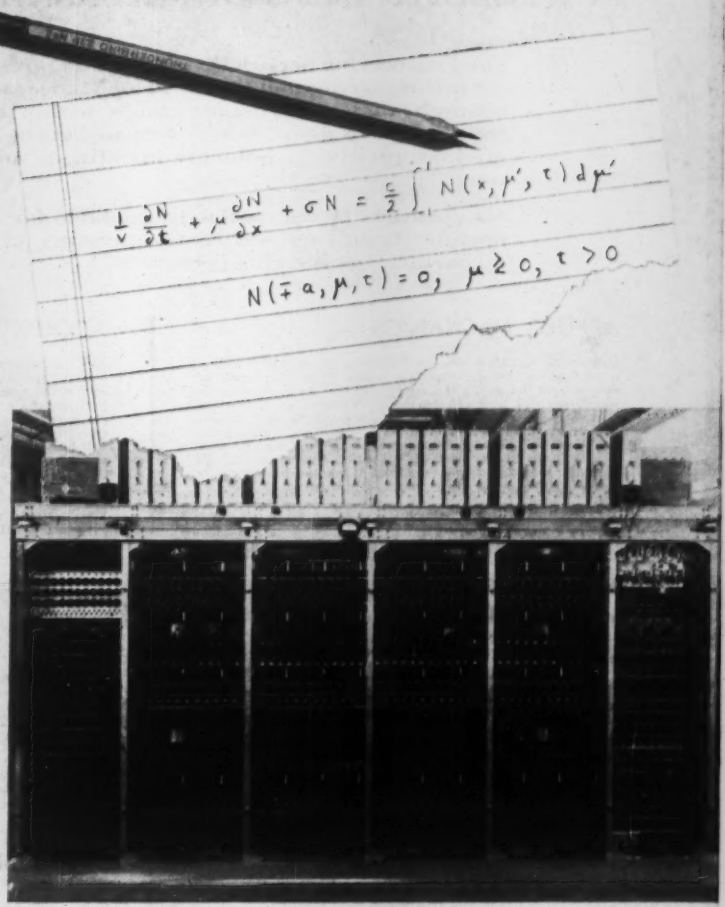
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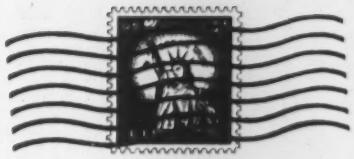

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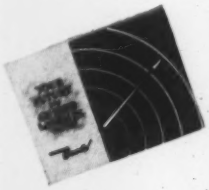

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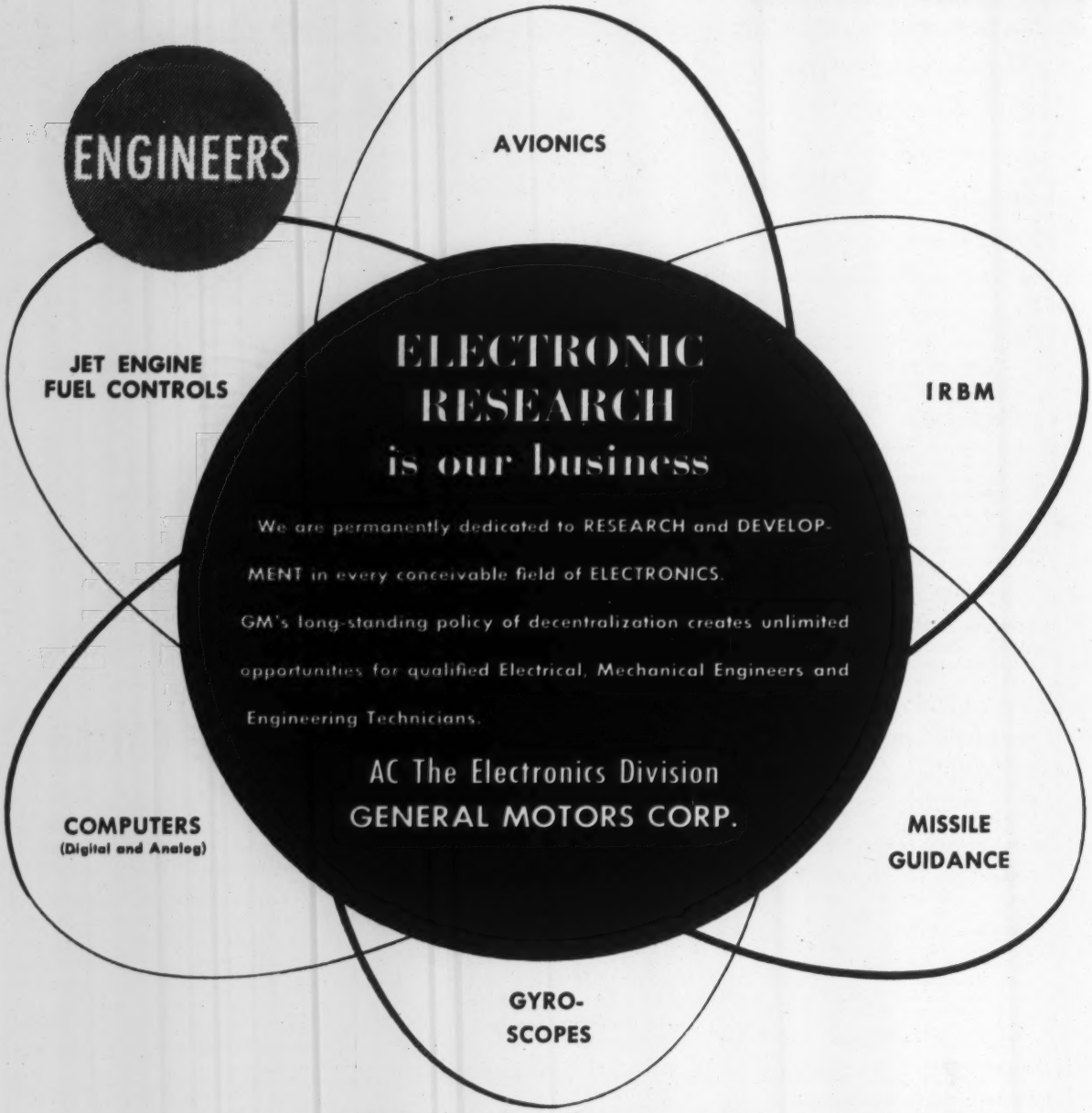
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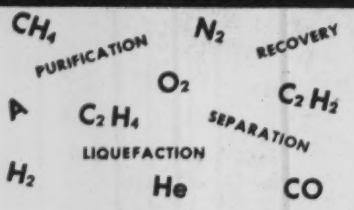

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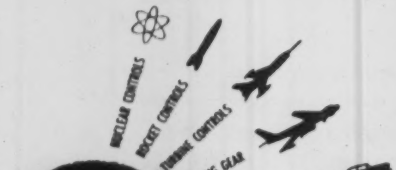

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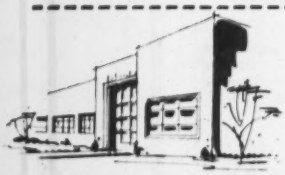

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...and now, mechanical engineers can help create RCA's advanced airborne weapons systems

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Lockheed

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Field of engineering

Home Address

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Duties will consist of process equipment design and project engineering.

Location: Memphis, Tennessee

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Send resume to:

Technical Division, Personnel
THE BUCKEYE CELLULOSE CORPORATION
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MECHANICAL ENGINEERS

Ethyl Corporation is seeking mechanical engineers with BS degree for project engineering and inspection work. While applicants with from 2 to 5 years' experience are preferable, the experience is not absolutely essential.

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Interested persons are invited to submit a complete resume of their training and experience to:

Mr. R. S. Asbury
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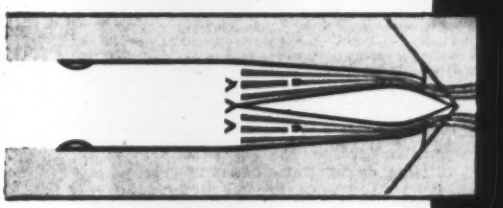

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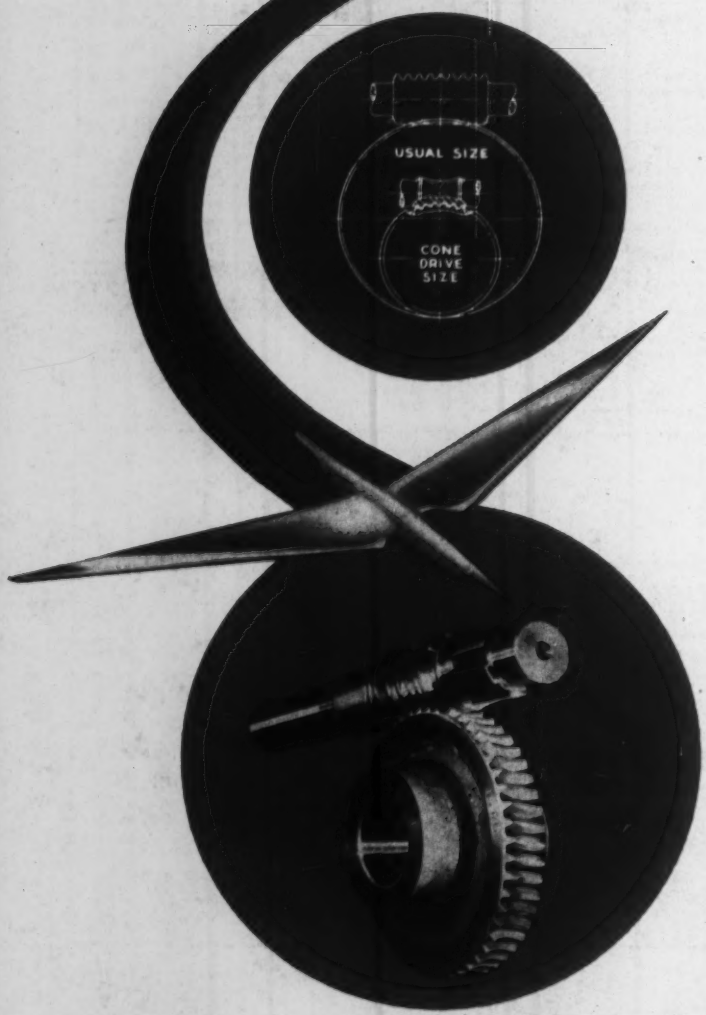

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Ruthman Machinery Co.

Sanborn Co.
Shenango Furnace Co.
*Smith, S. Morgan Co.
Stephens-Adamson Mfg. Co.
Stillwater Clay Products Co.
Sturtevant, P. A., Co.
Synchro-Start Products (Inc.)
*Syntron Co.

*Titusville Iron Works Co.
Div. of Struthers Wells Corp.

*Union Iron Works
*U. S. Hoffman Machinery Corp.
Universal Drafting Machine Corp.

Walworth Co.
Watson-Stillman Press Div.
Farrel Birmingham Co.
Western Gear Corp.
Wheeler, C. H., Mfg. Co.
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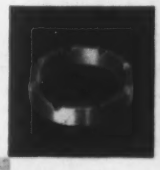

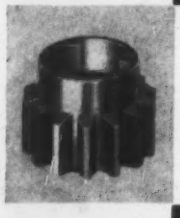

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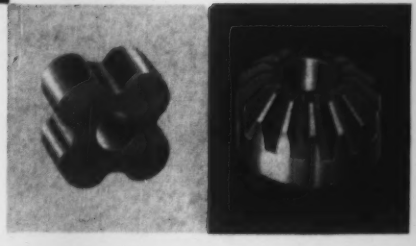

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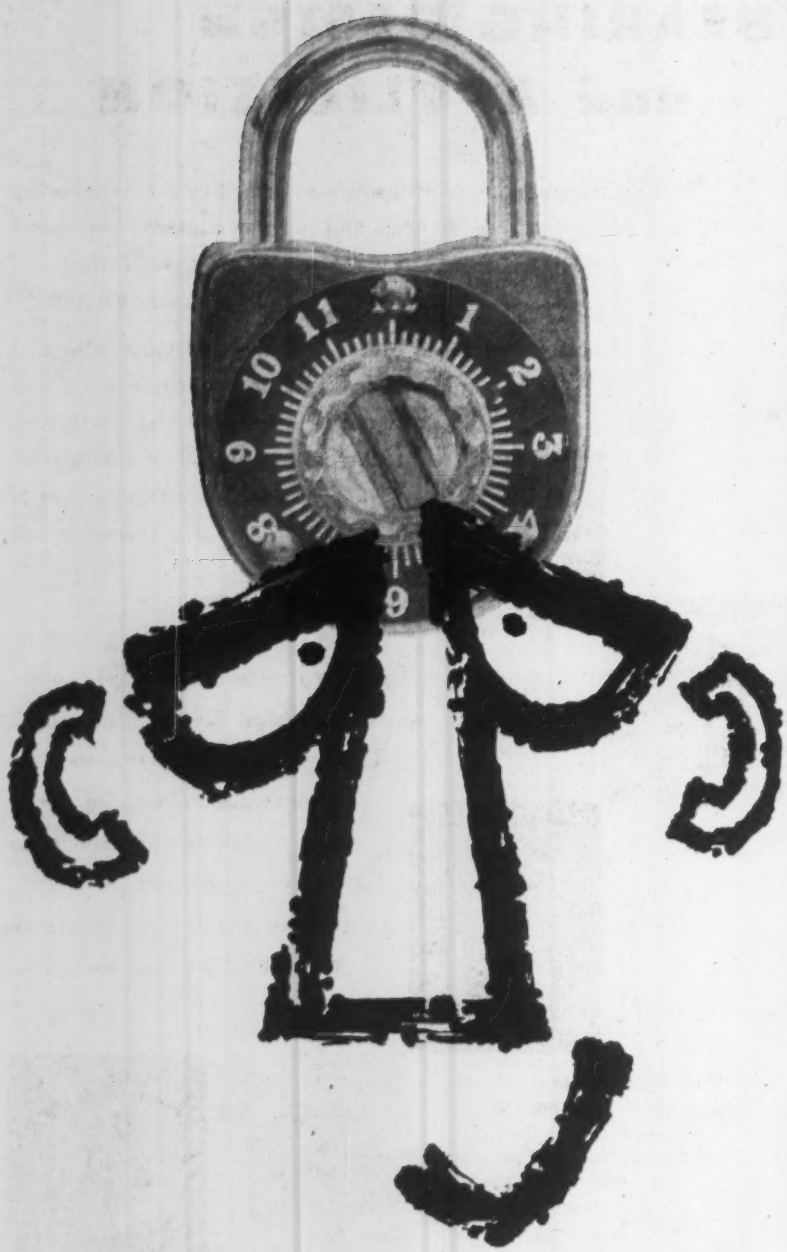
BUSHINGS, BEARINGS, BARS AND SPECIAL PARTS OF CAST BRONZE AND POWDERED METAL

The Bunting Brass and Bronze Company • Toledo 1, Ohio • Branches in Principal Cities



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If it deals with guided missiles, you'll find Firestone has the key to unlock it—and open the door to a happier future for you. Firestone's creative climate and tangible rewards keep that door open to a steady flow of achievement and growth.

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. . . with *union* body-bonnet joint on 125 lb., 150 lb., 200 lb. pressure classes

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Union ring nut provides safety-tight body-bonnet joint

The separate union nut seals the bonnet and body mating surfaces, effecting a tight, leak-proof joint. Possibility of distorting body and bonnet during disassembly and assembly and of loosening the joint during operation are virtually eliminated.

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Necessity for stem replacement can be forgotten, because stems are special, long-lived OIC *Alloy-40*. This sturdy material eliminates galling and seizing and contributes to easy operation.

Stem threads are never exposed to line fluids in open or closed positions (125 lb. and 150 lb.), preventing thread abrasion from line fluids or suspended solids.

All pressure parts are designed for maximum strength, and working parts are hydrostatically tested for positive sealing and seating. Write for our folder, No. 1006. ***Order from your OIC distributor.***

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Produces automotive parts automatically ...with TIMKEN® bearings, the precision is automatic, too

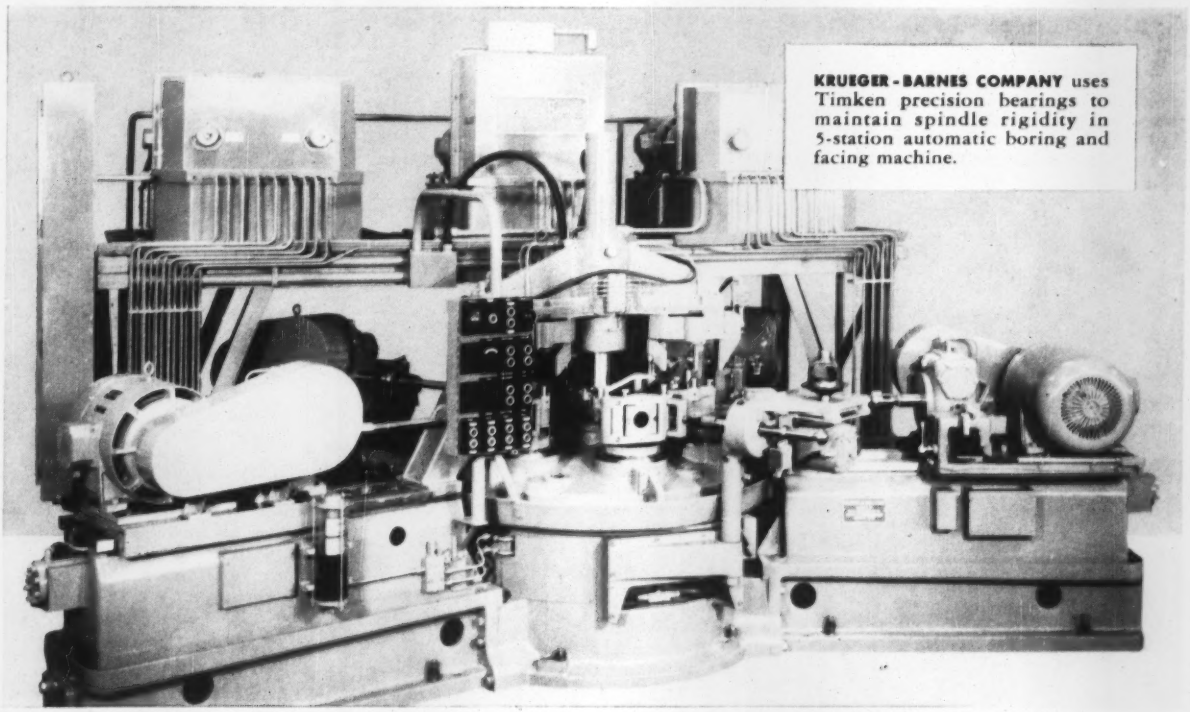
KRUEGER-BARNES engineers designed this 5-station milling and boring machine to produce automotive differential cases semi-automatically. To be sure its precision was automatic, too, they mounted the 5 spindles on 10 Timken® tapered roller bearings. Timken bearings take the work loads, keep the spindles rigid through hour after hour, shift after shift of high-speed operation. And they do it with a minimum of attention and maintenance.

Timken bearings maintain spindle rigidity because their tapered design lets them take both radial and thrust loads in any combination. And full line contact of rollers and races in Timken bearings gives them extra load-carrying capacity.

Timken bearings are designed by geometrical law to have true rolling motion and precision manufactured to live up to their design. Manufactured with an incredibly smooth surface finish, Timken bearings virtually eliminate friction, help keep machines on the go with less maintenance.

Since Timken bearings are engineered for the job, precision manufactured and made of special analysis Timken fine alloy steels, they normally last the life of the machine. In machine tools as in all machinery, wherever wheels and shafts turn, Timken bearings are your No. 1 value. When you build or buy machines, specify Timken bearings. Look for the trade-mark "Timken" on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



KRUEGER-BARNES COMPANY uses Timken precision bearings to maintain spindle rigidity in 5-station automatic boring and facing machine.

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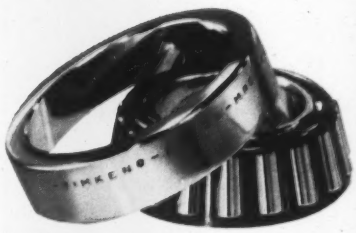

TAPERED ROLLER BEARINGS ROLL THE LOAD